Academic Rules and Regulations

2020 (Revision 1.0)

(Applicable for the students admitted during 2021 – 2022 and 2022 – 2023 only from the upcoming semester from the date of approval)

Undergraduate Programs

Choice Based Credit System (CBCS)

NSRIT

Nadimpalli Satyanarayana Raju Institute of Technology (NSRIT)
Sontyam, Andhra Pradesh 531173
(An Autonomous Institute, Affiliated to JNTU - Gurajada, Vizianagaram, AP)
Accredited by NAAC with 'A' Grade

Head of the Department
Computer Science and Engineering
N.S .Raju Institute of Technology
Sontyam, Visakhapatnam - 531173

Contents

Revision	1.0
Year of introduction	2023
Approved	VI Academic Council
Date of approval	

Sign and Seal of the Chairman (ACM)

The Vision

To promote societal empowerment and become an institution of excellence in the field of engineering education and research

The Mission

- To develop the students into outstanding professionals through innovative Teaching - Learning process
- To uphold research through long term Academia - Industry interaction
- To inculcate ethical standards and moral values

Academic Regulations for B. Tech. (Regular, Honors and Minor with Specialization) Program
(For all the candidates admitted from the Academic Year 2020 – 2021 onwards)
B. Tech. (Regular: 160 Credits | Lateral Entry: 121) | B. Tech. (Honors/Minor – Regular: 180 Credits | Lateral Entry: 141)

1. Preliminary Definitions and Nomenclature

In this regulation, unless the context otherwise requires:

a. **Degree:**The academic award conferred upon a student on successful completion of a programme designed to achieve the defined attributes. It is referred to as Under-Graduate (UG) Degree, that is B.Tech. degree

b. **Program:** The cohesive arrangement of courses, co-curricular and extracurricular activities to accomplish predetermined objectives leading to the awarding of a degree. It also means specialization or discipline of B.Tech.

c. **Course:**Theory, Practical or Theory-cum-Practical subject studied in a semester, like Engineering Mathematics, Physics, etc.

d. **"University"** means Jawaharla Nehru Technological University – Gurajada, Vizianagaram (JNTU – GV)

e. **"Institute"** means Nadimpalli Satyanarayana Raju Insitutute of Technology (NSRIT)

2. Eligibility for Admission

2.1. Admission to the B. Tech. (Regular, Honors and Minor with Specialization) shall be made subject to the eligibility and qualifications as prescribed by Andhra Pradesh State Council for Higher Education (APSCHE), Government of Andhra Pradesh. The total number of seats as per the approved annual intake is categorized into two categories viz. Convenor Quota (Cat. – A) and Management Quota (Cat. – B) with a ratio of 70:30 (G. O. No. 52). The admission under Cat. – A shall be done based on the merit score secured through state-wise common state commone entrance test i.e., AP Engineering Agricultural, Pharmacy Common Entrance Test (AP – EAPCET). The allotment pertaining to Cat. – B admission, the merit list based on 10+2 shall be taken as a benchmark in compliance with the norms issued by APSCHE

2.2. With regard to the students admitted through Lateral Entry Scheme, the students shall be admitted directly into semester III of the second year of B. Tech. programs. Under this scheme 10% seats of the sanctioned intake will be available in each program of study as supernumerary seats. Admissions to this 3 year B. Tech. lateral entry Programme will be through Andhra Pradesh Engineering Common Eligibility Test (ECET). The maximum period to complete B. Tech. under lateral entry scheme is 6 consecutive academic years from the date of joining

3. Duration and Medium of Instruction of the Program

The program duration for the award of degree in B. Tech. (Regular, Honors and Minor with specialization) will be of 4 academic years and each academic year will have two semesters. In case, if the student is unable to complete the program in the above said stipulated duration, he/she shall be permitted to complete the program of study within 8 consecutive academic years from the year of admission into B. Tech. program. For the students admitted through lateral entry scheme the duration of the program is 3 years and 6 years if the student fails to complete the program of study in the

stiiupulated duration of 3 years. The student who fails to meet the requirements for the award of B. Tech. program during the above said extended duration shall forfeit the degree in B. Tech. program of study. The medium of instruction during the program of study is English.

Academic Calendar: As already mentioned, each academic year will have two semesters. Each academic year, an academic calendar will be issued by the Office of the Controller of Examinations (CoE) indicating the duration of instruction period, mid-term tests, semester-end examinations, practical examinations and eventually evaluation. Normally each semester will have fifteen weeks of instruction, one week of practical examinations and two to three weeks for descriptive examinations. In total, each semester will span for a maximum duration of 15 – 19 weeks.

4. **Programs of Study**

   NSRIT offers seven programs of four year duration leading to Bachelor's Degree in Engineering and Technology (B. Tech.) as follows

   i. Civil Engineering
   ii. Computer Science and Engineering (CSE)
   iii. Computer Science and Engineering (Artificial Intelligence and Machine Learning)
   iv. Computer Science and Engineering (Data Science)
   v. Electronics and Communication Engineering (ECE)
   vi. Electrical and Electronics Engineering (EEE)
   vii. Mechanical Engineering

5. **Structure of Programs**

   5.1. **Categorization of Courses**

   Each program shall have a common curriculum framework with well defined educational objectives, program outcomes and courses outcomes as per the philosophy of Outcome Based Education (OBE) in line with the Vision and Mission of the department offering the program and in turn in accordance with the Vision and Mission of the Institute. The program structure comprise of theoretical courses, practical courses, theory-cum-practical courses, MOOCs, summer and full semester internship, skill oriented courses, project work, seminars and other relevant courses meeting industry requirements. As the curriculum is framed with Choice Based Credit System (CBCS), the students have the flexibility in opting the courses of their choice under the category of electives. The courses of a particular program are categorized as follows

   a. Foundation Courses
      i. Humanities and Social Science including Management (HS)
      ii. Basic Science (BS)
      iii. Engineering Science (ES)
   b. Professional Core Courses relevant to the chosen program of study
   c. Electives
      i. Professional Electives (PE) relevant to the chosen program of study
      ii. Open Electives (OE) relevant to other programs of study
   d. Project, Seminar and Internship
   e. Skill Oriented Courses (SOC) and Industry Connect Courses (ICC)
   f. Mandatory Courses (MC) as prescribed by AICTE / UGC

5.2. Nomenclature of Credit Distribution

No.	Nature of Course	Credit	Nomenclarture
1	Theory Course / Elective Course (per Hour)	1.0	1 hour / credit
2	Practical / Drawing Course (per Hour)	0.5	0.5 hour / credit
3	Summer Internship (2nd Year | 3rd Year)	1.5 | 3.0	-
4	Full Semester Internship	6.0	-
5	Capstone Project	6.0	-
6	Moocs (Per Hour)	1.0	1 hour / credit
7	Skill Advanced / Soft Skill Course (per Hour)	2.0	0.5 hour / credit
8	Mandatory Course	-	-
9	Counseling/Mentoring	-	-
10	Sports/Hobby Clubs/Activities	-	-

5.3. Structure of Curriculum

Sem	No. of Theory Courses	No. of Lab Courses, Internship, Term Paper, Project	Total Credits
I	5 Theory	3 + Sports/Hobby Clubs/Activities	19.5
II	6 (5 Theory + 1 MC)	3 + Sports/Hobby Clubs/Activities	19.5
III	7 (5 Theory + 1 SOC + 1 MC)	3 + Sports/Hobby Clubs/Activities	21.5
IV	6 (5 Theory + 1 SOC)	3 + Sports/Hobby Clubs/Activities	21.5
V	7 (3 Theory + 1 PE + 1 OE + 1 SOC + 1 MC)	2 + Sports/Hobby Clubs/Activities + Summer Internship #1	21.5
VI	7 (3 Theory + 1 PE +1 OE + 1 SOC + 1 MC)	3 + Sports/Hobby Clubs/Activities	21.5
VII	7 (3 PE + 2 OE (MOOCs) + 1 Elective (HS) + 1 SOC)	Summer Internship #2	23
VIII	Project	Full Semester Internship	12
		Total Credits	**160**

5.4. Credit Distribution for each Category

No.	Category	Credits	
		Regular	Lateral
1	**Foundation Courses**	**55.5**	**13.5**
	Humanities and Social Science including Management (HS)	10.5	06.0
	Basic Science (BS)	21.0[1]	06.0[1]
	Engineering Science (ES)	24.0[1]	04.5[1]
2	**Professional Core Courses**	**51.0[1]**	**51.0[1]**
3	**Electives**	**27.0**	**27.0**
	Professional Electives	15.0	15.0
	Open Electives	12.0	12.0
4	**Project, Seminar and Internship**	**16.5**	**16.5**
5	**Skill Oriented Courses**	**10.0**	**10.0**
6	**Mandatory Courses** as prescribed by AICTE and UGC (Not to be accounted for CGPA)	-	-
7	**Audit Course**	-	-
	Minimum credits to be earned for the award of the B. Tech. (Regular) degree	160	121

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[1]The total number of credits may have marginal variation from one program to other program based on the requirement to accomadate few eseential courses related to the program of study

5.5. Assessment Pattern for the Courses

With the true spirit of implementing Outcome Based Education (OBE), each course is designed with customized assessment pattern addressing the various cognitive levels of Revised Bloom's Taxonomy (RBT) with appropriate proportion covering the breadth and depth of the courses. The Assessment Instrument or QPs shall be designed with a combination of question responses with short answer, long answer, higher order thinking skills through critical thinking and creativityand MCQ that fits best to the assessment of the intended learning outcomes. The course instructor can also take the liberty of setting their own customized question papers along with the distribution of marks leveraging the status of autonomous promoting higher order thinking skills and creativity through case studies or questions related to problems solving skills through open book examinations other than that of the one prescribed in the academic regulation 2023. This shall be deployed by taking necessary approval from the respective Chairman, Board of Studies and the Head of the Institution as well before the commencement of the course while preparing the course plan along with the rubircs indicating the criteria and scale/metirc for assessment. With regard to the assessment pattern for the skill oriented courses, appropriate assessment instrument shall be developed by the respective course facilitator that suits to assess the skills that are expected from the courses by taking approval from the respective Chairman, Board of Studies and the Head of the Institution as well before deploying for assessment. Incase of video based grading, suitable rubrics shall be developed for mearing the course outcomes or intended learning outcomes. In all the cases other than the assessment pattern being prescribed in the academic regulation 2023, the pattern of customized assessment pattern shall be submitted to the office of the Controller of Examinations before the commencement of the course.

5.6. Internship / Community Service Projects (CSP)

As per the guidelines specified in these regulations, each student is expected to undergo community service projects (CSP),internship in the form of summer and full semester internship (FSI) during the program of study and it is mandate for all the students. The curriculum offers two summer internships i.e., one at the end of second year and the other one is at the end of third year of study; each one spans for a duration of four to eights weeks. The CSP shall be taken at the level of second year as an alternate option to summer internship (Phase I) as per the standard operating procedure prescribed by the institution and the allotment is purely at the discretion of the Industry – Institute Engagement cell based on the requirement and availability of internship offers. With regard to the FSI, the curriculum provides flexibility at two different slots during VII and VIII semesters with a span of 12 weeks – 16 weeks. The students who are opting FSI either during semester VII or VIII shall register for the course during the semester V through the Head of the department and the same shall be forwarded to the Office of Controller of Examination (CoE) and Internship Cell. To ensure effective implementation of FSI, the Institute shall depute ~50% of the interns during semester VII and the rest during semester VIII. Accordingly, the courses pertaining to the semesters shall be inter-changed. The students who are opting for FSI in semester VIII shall be permitted to take up the capstone projectat the industries along with the FSI in the same industry,if he/she is interested and submit a separate report along with internship/training report.

Students will be evaluated by a panel of internal and external subject matter experts (SMEs) nominated by the Office of the CoE. It is mandate for all the learners going either for internship / CSPs to capture a video demonstrating the self reflection on the learning outcomes for grading by the course supervisor/guide.

5.7. Project Work

Each student is expected to carryout one capstone project relevant to his/her program of study or interdisciplinary of nature leading to design, development of solutions, and fabrication of system component or a product. On successful completion of the project work, the students are expected to submit a detailed project report along with the working models, if any for evaluation. The office of the CoE shall nominate a team of experts to assess the quality and evaluate the project as per the evaluation guidelines prescribed in the academic regulation. Incase, if any student is interested in doing industry oriented project (Individual) atthe industries or research organization, he/she shall take up the project duly approved by the Head of the Department, CoE and the Head of the Institution well before the commencement of the course. In such cases, the students should inform the respective department well in advance, preferably during semester VII. The students who opted FSI in the semester VII shall take up the courses as prescirbed in the curriculum during semester VIII along with the capstone project.

5.8. Statutory Mandatory Courses and Audit Courses

Mandatory courses are those courses which are designed inline with the requirement of AICTE. These courses do not carry any credits and are not accounted for the calculation of CGPA.The students shall register for the courses in the respective semester as specified in the curriculum. All the students (regular and lateral entry students) shall complete the mandatory course by taking two assessment in the form of multiple choice questions during the continuous assessment. A minimum of 40% of marks (average of two continuous assessment) is required to complete the course and the status of completion will be indicated in the grade memo and an online certification is also mandatory for a duration of 30 hours in the relevant area as specified in the curriculum. In addition to the above, the curriculum provides flexibility to nurture employability skills through audit courses and it is mandatory for all students to complete the audit courses for the award of the degree and it will not be counted for the calculation of CGPA. The academic regulation permits autonomous learning with mandatory courses promoting self learning ability among the learners.

5.9. MOOCs and Autonomous Learning

The curriculum provides adequate flexibility for the students to take up MOOCs through self-study mode enabling them to learn the courses on independent/autonomous mode with minimal guidance of faculty mentor to earn necessary credits for the award of the degree B. Tech. (Regular) and B. Tech. (Honors & Minor with Specialization) and the attendance is not mandatory. The courses shall be opted from MOOCs platform viz. NPTEL, SWAYAM or any other platforms as approved by the respective Chairman, Board of Studies (BoS). Incase of MOOCs through NPTEL, SWAYAM, the credits shall be directly transferred without conducting any further examination from the institution. For all other platforms, the assessment pattern for such courses which are part of the curriculum for the B. Tech. (Regular) degree shall be carried out as similar to

other regular theory and skill-oriented courses. And for B. Tech. (Honors) and B. Tech. (Minor with Specialization) shall be inline with the agencies or the platforms offering these courses. Further, if the grade is not specified by the particular agency or platform, the office of CoE shall follow the institutional SOP for the award of the grade and take necessary approval from the Academic Council through circulation. MOOCs shall be identified by the respective department taking necessary approval from the BoS/Chairman (BoS) and shall be intimated well in advance to the students. Futher, in case, if the student is preferred to undergo Semester Away Programme as per Clause 5.11 during semester VII, the credits earned through self-study courses shall be compensated for the calculation of CGPA. The curriculum provides flexibility to the students to select the semester VII on self-study mode to facilitate the Semester Away Program. Incase of notification of On-Job Training (OJT) by the institute industry-institute engagement cell during semester VI through VIII, the academic regulations 2023 provides flexibility enabling the students to opt self learning in the respective semester and can appear for continuous assessment and semester end examinations as per the examinations schedule and fulfill the credit requirement for the award of the B. Tech. program. In such cases, the attendance at the industries/research organization shall be taken for promotion from one semester to subsequent higher semesters for a duration of 15 weeks.

5.10. Industry Supported Courses

a. Students can opt for one-credit courses, offered by experts from industry/research organizations which are approved by academic council. Students can register such coursesfrom his/her second year of study as and when these courses are conducted by various departments. A student is also permitted to register for the courses of other departments, provided the student has fulfilled the necessary pre-requisites of the course being offered andsubject to the approval of both the Heads of Departments. There is no limit to the number of 1-credit or 2-credit courses a student can register during the programme of study. However, a student can register for only one course in a semester. These courses are evaluated by the respective course coordinator of the programme. The maximum number of credits that can be earned from industry supported courses is limited to four

b. If a student does not successfully complete the registered industry supported 1-credit or 2-credit courses in a semester, the registration of that course will be considered as cancelled. Further, it will not be treated as arrear and no supplementary examination will be conducted; alternatively, if he/she wishes, he/she can re-register for the same course in the ensuing semesters and successfully complete it as and when it is offered subsequently

c. The credits earned through these courses will be treated over and above the credit requirement for the award of the B. Tech. (Regular, Honours and Minor with specialization) programs

5.11. Semester Away Programme (SAP) to Promote Multi-disciplinary Skills (Choice Based Semester System):

The interested students can have the option of undergoing Semester Away Programme leveraging Choice Based Semester System during semester VII with Higher Learning Institutions at Foreign Countries or Institutions of National Repute or Research Organizations in India, by earning necessary equivalent credits in the semester VII through course study, projects or whatever terms and conditions as prescribed by the respective organization.In addition to the above, the students can opt a combination of 1-, 2-, 3-, 4-credit

courses to compensate the credits required for semester VII on self study mode in case of shortage of credits.The students who are interested to opt for SAP shall register to the office of CoE during the beginning of semester III and initiate self-study mode for futuristic compensation of credits. The registration for this SAP is valid as long as the students maintain 8.0 CGPA in all semesters with no history of arrears. Incase, if the student fails to register during the above said period, he/she may register for the same by taking prior permission from the respective Head of the Department. Further, the students are encouraged to opt inter-disciplinary courses of their interest (need not be in the area of the program of study). The Controller of Examinations shall ensure that necessary approvals are taken from the Academic Council well before the time period of their SAP. In case of any uncertain circumstances, if the student fails to complete SAP, the registration will be cancelled automatically and he/she can earn the credits required for that particular semester through self-study mode.

5.12. Procedure for Awarding Marks for Continuous Assessment

Theory(Internal: 30 Marks | External 70 Marks)

Continuous Internal Assessment #1 (First two and half units with a duration of 90 Minutes)

Descriptive Examination	: 20 Marks
Assignment	: 05 Marks

Continuous Internal Assessment #2 (Next two and half units with a duration of 90 Minutes)

Descriptive Examination	: 20 Marks
Assignment	: 05 Marks

Comprehensive Quiz (50 Multiple Choice Questions each carries 01 mark and scaled down to 05 Marks)

The final internal marks will be awarded by considering equal proportion for both the CIA which shall be scaled down to 25 marks and 05 marks from comprehensive quiz.

Laboratory Courses (Internal: 30 Marks | External: 70)

Total Internal Marks	**: 30 Marks**
Distribution for Continuous Evaluation	
Continuous Assessment	: 10 Marks
Record	: 10 Marks
Internal Test	: 10 Marks
Total External Marks	**: 70 Marks**
Experiment & Viva - Voce	: 50 Marks
Video assessment (Learning outcome)	: 20 Marks (One video shall be uploaded by the student demonstrating the self reflection on that particular laboratory course for grading)

Drawing and Design Related Courses(Internal: 30 Marks | External: 70 Marks)

Total Internal Marks	: 30 Marks
Distribution for Continuous Evaluation	
Continuous Assement	: 15 Marks
Internal Test	: 15 Marks
Total External Marks	: 70 Marks

There shall be two internal tests in a semester for 15 marks each and final marks will be calculated by considering equal proportion for both the CIA.

Mandatory Courses

Assessment   :As prescribed in the Academic Regulation

Online certification course   :01 course (in the relevant area of the pursuing mandatory course with a minimum duration of 30 hours and the students need to submit the certification of completion and assessment compliance issued by the respective online learning platforms)

Technical Paper Writing

Internal Review #1	: 10 Marks
Internal Review #2	: 10 Marks
Final Review and Presentation	: 30 Marks

Paper Publications: Students are requested to publish their review articles to either peer-reviewed journals or any one of the reputed conferences and submit the published paper. It is mandatory for the award of the degree. Academic regulation suggest to publish the articles either in UGC – CARE or journals indexed by SCOPUS.

Summer Internship (Internal: 50 Marks)

Interim Assessment and Report Writing	: 20 Marks
Final Presentation	: 30 Marks

Full Summer Internship (Internal: 100 Marks | External: 100 Marks)

Interim Review #1 (Industry Supervisor)	: 20 Marks (Rubrics based)
Interim Review #2 (Industry Supervisor)	: 30 Marks (Rubrics based)
Terminal Presentation	: 15 Marks (Presentation)
Report	: 25 Marks
Video based assessment	: 10 Marks

In all the continuous assessment pertaining to internship, the major focus of the assessment will be predominently on skills and application of knowledge viz. Communication Skills, Team-Work, Organization Skills, Interpersonal Skills, Analytical and Problem Solving Skills, Leadership Skills, Work Ethics and any specific intiatives by the interns.

Skill Oriented Courses (Internal: 50 Marks)

Interim Assessment and Report Writing	:15 Marks

Outcomes   : 20 Marks
Final Presentation   : 10 Marks
Video based assessment   : 05 Marks

The outcomes shall be in the form of design, development of working model of a system component or a product and these 20 marks shall be awarded based on Rubrics that addresses Critical Thinking, Creativity, Collaboration and Communication.

Project (Internal: 100 Marks | External: 100 Marks)

Distribution of Marks (Continuous Internal Assessment)
Innovativeness of the Project   : 10 Marks
Literature Survey   : 05 Marks
Experimentation/ Simulation   : 15 Marks
Presentation, Interpretation&
Analysis of Results   : 15 Marks
Interim Review #1(Presentation)   : 05 Marks
Interim Review #2 (Presentation)   : 05 Marks
Product Development   : 15 Marks
Terminal Presentation   : 10 Marks
Report   : 05 Marks
Publication in Conference / Journal (CARE)   : 05 Marks
Video based assessment   : 05 Marks (Mandatory)
Online Certification   : 05 Marks (Mandatory)

The online certification shall be from MOOCs platform with a minimum duration of 30 – 45 hours and the student need to earn the certification and for which there will not be any further assessment from the institution or program of study.

A student shall earn the following percentage of minimum percentage of marks in each theory, practical, design and drawing course in B. Tech. program.

- A minimum of 35% (24 and above out of 70 marks) of marks for each course Semester End Examinations (SEE) and
- A minimum of 40% marks for each course considering both CIA and SEE taken together

6. Attendance Finalization and Result Declaration

6.1. Procedure

The attendance shall be calculated as per this autonomous regulation 2020 for the students to appear for the end semester examinations as per clause 6.2. The Institute shall formulate a committee "Joint Board" constituting of Principal (Chairman), Chairpersons of all Boards of Studies, Controller of Examinations (Member Secretary) and two senior members of faculty. The tenure for the senior members of faculty shall be of 2 years. The member secretary shall place the attendance of all the students before the Joint Board for approval before the finalization and declaration of attendance. The same procedure shall be adopted for declaring the end semester examination results.

6.2. Attendance Requirements and Result Declaration Procedure

a. A student shall be eligible to appear for the end semester examinations if he/she acquires a minimum of 75% of attendance in aggregate of all the courses in a semester and shortage of attendance below 65% shall in no case be condoned and such cases will not be permitted to appear for the end semester examinations

b. Condonation for shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be permittedbased on medical leave (hospitalization / accident / specific illness) and on-duty leave for participation in College / University / State / National / International Sports events with prior approval from the competent authority. After taking necessary approval from the Head of the Institution or Competent Authority, the student shall be permitted to appear for the end-semester examination by paying the condonation fee as prescribed by the Office of CoE. However, the student who have represented the college in outside world activities shall be exempted in paying the condonation fee

c. A student who has secured less than 40% of attendance in a particular course shall not be permitted to appear for the end semester examination though he/she maintains more than 75% of attendance in aggregate of all courses in that particular semester. In such cases, the student need to reappear physically as and when the courses are being offered by the respective department and accordingly the time-table shall be optimized to avoid overlapping

d. Students, who do not meet the minimum required attendance in a semester, shall be detained in that particular semester and they will not be promoted to the next semester. In such cases, the student need to rejoin in that particular semester in the subsequent academic year

e. Academic regulations applicable to the semester in which re-admission is sought shall be applicable to the re-admitted student

f. In case if there are any professional electives and/or open electives, the same may also be re-registered if offered by the respective program of study. However, if those electives are not offered in the later semesters, alternatively, the students may opt other electives from the same set of elective courses offered under that category in that particular semester

7. Promotion Policies

During the four year (Regular) or three year (Lateral) program of study, it is mandatory for all students to maintain a minimum of 40% of the credits pertaining to the current year of study to get promoted to subsequent year of study, say 2nd year to 3rd year and so on. In case if the student fails to earn the necessary percentage of credits required for promoting to subsequent year of the program of study, he/she will be detained and he/she need to earn the required credits and take re-admission in the subsequent years of the academic year to complete the B. Tech. degree program.

8. Eligibility for the Award of the Degree

A student shall be declared to eligible for the award of the degree in B. Tech. (Regular) program if he/she has fulfilled the following requirements

a. The student should earn the minimum requirement of credits (160 for regular admission and 121

credits for lateral entry) and cleared all the mandatory courses as prescribed in the curriculum within the maximum duration of 8 consecutive academic years (Regular) and 6 consecutive academic years (Lateral) from date of admission

b. The student should maintain more than 5 CGPA at any point of time

c. The student shall not have any pending disciplnary issues

The student shall forfeit his/her Degree and his/her admission stands cancelled if he/she fails to meet the above compliance.

9. **Award of Grades**

Range of Marks	Letter Grade	Grade Point
>= 90	'O'	10
>= 80 < 90	'A+'	09
>= 70 < 80	'A'	08
>= 60 < 70	'B+'	07
>= 50 < 60	'B'	06
>= 40 < 50	'C'	05
< 40	'F'	0
Absent	'AA'	0
Non completion of a semester (Repeat)	'I'	0
Withdrawal from end semester examination	'W'	0

After completion of the programme, the Cumulative Grade Point Average (CGPA) from the I Semester to VIII Semester (from III to VIII semester for lateral entry) is calculated using the formula:

$$CGPA = \frac{\sum_{i=1}^{n-1}(c_i \times g_i)}{\sum_{i=1}^{n-1} c_i}$$

where 'n' is the number of courses registered for, 'c_i' is the credits allotted to the given course and 'g_i' is the grade point secured in the corresponding course

10. **Classification of the Degree Awarded**

    a. **B. Tech. (Honors):** In addition to the requirement as cited in (10.c), if the student secures 20 additional credits in accordance with the clause (14), he/she shall be declared with B. Tech. (Honors)

    b. **B. Tech. (Minor with Specialization):** In addition to the requirement as cited in (10.c), if the student secures 20 additional credits in accordance with the clause (15), he/she shall be declared with B. Tech. (Minor with Specialization)

    c. **B. Tech. (Regular) - First Class with Distintion:** The student who qualifies for the award of the B. Tech. degree in the chosen program of study with 160 credits (Regular) and 121 credits (Lateral) within 5 consecutive academic years (Considering the formal approval for the break of study from the competent authority) from the date of admission at his/her first attempt maintaining 7.5 CGPA and above shall be declared to have passed in first class with distintion and should not have been prevented from appearing end semester examinations for the want of attendance requirements

    d. **B. Tech. (Regular) - First Class:** The student who qualifies for the award of the B. Tech. degree in the chosen program of study with 160 credits (Regular) and 121 credits (Lateral) within 4 consecutive academic years from the date of admission maintaining 6.75 CGPA and above shall be declared to have passed in first class and should not have been prevented from appearing end semester examinations for the want of attendance requirements

e. **B. Tech. (Regular) - Second Class:** The student who qualifies for the award of the B. Tech. degree in the chosen program of study with 160 credits (Regular) and 121 credits (Lateral) within 8 consecutive academic years from the date of admission maintaining 5.75 CGPA and above and less than 6.75 CGPA shall be declared to have passed in second class

f. **B. Tech. (Regular) - Pass:** All other students who have not covered and qualifies for the award of the degree maintaining 5.00 CGPA and above and less than 5.75 CGPA shall be declared to get Pass with minimum credit requirement for the award of the degree in B. Tech. program

11. Flexibility to Add or Drop Self Study Courses (SSC)

a. It is mandatory that all the students need to earn the minimum number of the credits for the award of B. Tech. degree in their respective program of study. However, a student can earn more number of credits if he/she opt, by registering additional courses, from the list of courses available in the curriculum of all disciplines, over and above to the existing courses from semester IV – VI. The student shall be permitted to drop any SSC at any point of time and registration for such courses gets cancelled and will not be reflected in Cumulative Grade Memo (CGM)

b. All the courses registered and cleared by a student in this mode will be mentioned in the CGM as additional acquired. However, the CGPA is calculated as per the minimum requirement of the credits for the award of the B. Tech. degree

12. Withdrawal from the Examination

a. A candidate may, for valid reasons, be granted permission by the Principal to withdraw from appearing for the examination in any course or courses of only one semester examination during the entire duration of the Degree Programme. Also, only ONE application for withdrawal is permitted for that semester examination in which withdrawal is sought

b. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination and if it is made prior to the commencement of the examination in that course or courses and also recommended by the Head of the Department

c. Such withdrawal from the examination shall be treated as absent for the 1st attempt to the respective examination and will lose the eligibility for First Class with Distinction

d. If any student is intended to drop FSI subsequent to his/her registration followed by allotment, he/she needs to re-register the course

13. Transitory Regulations: To enable the students to take admission or entry into NSRIT from other Institution either by Transfer, Re-admission, Admission, or Transfer from other engineering Institution affiliated to JNTUK/Academic regulation within the Institute, the following regulations shall be followed based on the nature of case as cited above.

- Transfer of candiate from Autonomous / Non-Autonomous Institution affiliated to JNTUK
- Within the Institution from one regulation to other academic regulation

a. Transfer of a candidate from Autonomous / Non-Autonomous Institution affiliated to JNTUK

Any canddate who is interested to take admission in NSRIT from a non-autonomous engineering institution affiliated to the parent university either in the semester III or thereafter, shall acquire the

credits required for graduation as per the Institute autonomous regulations and the candidature shall be treated under following category

Students from non-autonomous institution seeking admission into semester III shall be treated in par with the students taking admission for 3 year program of study (i.e. lateral entry students) and should have cleared all the courses in the semester I and II as per university regulation. The same shall be calculated as per NSRIT regulations if the student is seeking admission into NSRIT from an autonomous institution. The credits earned during semester I and II shared be calculated as per the Institute autonomous regulations and in case if the earned credits during first two semestersare not adequate to take admission in the semester III, the student shall take additional courses approved by the respective Board of Studies and Academic council during semester III at NSRIT on self study mode and the same procedure shall be followed for taking admission into higher semesters

b. **Within the Institution from one regulation to other academic regulation**

A student taking admission under one regulation, say Academic Regulation 2020 in the first year, shall continue with the same regulation and should earn the necessary credits as metioned in the academic regulation at the time of joining. However, In case of readmission into a subsequent new regulation, and if the readmission is into any of the semesters from semester I through IV, the student shall follow the current regulations to which he/she taking admission and continue with the same regulation till graduation. In case of any credit shortage, the necessary credits shall be earned on self study mode to compensate the required number of credits. In case of excess credits, it will be treated as over and above.

In both the cases (a) and (b), the details shall be forwarded to the parent university along with the proceedings of the Academic Council.

14. **B.Tech. (Honors):** The curriculum provides flexibility to enable the students to register for B.Tech. (Honors) program by earning additional 20 credits which is over and above the requirement for the award of B.Tech.(Regular) degree. He/She shall register in the office of the CoE during semester III provided he/she secures ≥8 CGPA without backlogs in earlier semesters. If he/she wishes to withdraw from B.Tech. (Honors) program at any point of time, the credits obtained will not be compensated for the award of the degree and considered as over and above. The maximum enrollment B. Tech. (Honors) shall be restricted to 10% of the total intake in a particular batch of students.

The additional 20 credits shall be earned by opting four 4-credit courses offered by the respective program of study which are categorized in the curriculum and these courses shall be offered with a combination of guided learning or taught courses or self study mode depending on the total number of students registered for that particular course and the Chairperson of the Board of Studies reserves the right to decide the mode of delivery. Apart from this, he/she shall choose two 2-credit MOOCs of 30 hours or 6 weeks duration. Above all, if any student fails to maintain the 8 SGPA in the subsequent semesters after semester III, the registration for the B. Tech. (Honors) program stands cancelled without any notification. In case of students admitted through lateral entry, the CGPA compliance will be considered from semester III onwards as already mentioned.

15. **B.Tech. (Minor with Specialization):** The curriculum provides flexibility to enable the students to register for B. Tech. (Minor with Specialization) program by earning additional 20 credits which is over and above the requirement for the award of B. Tech. (Regular) degree. He/She shall register in the office of the CoE during the semester III provided he/she secures ≥8 CGPA without backlogs in earlier semesters. If he/she wishes to withdraw from B. Tech. (Minor with Specialization) program at any point of time, the credits obtained will not be compensated for the award of the degree and considered as over and above. In case of students admitted through lateral entry, the CGPA compliance will be considered from semester III onwards.

The student shall opt three inter-disciplinary courses each of 3-credit as listed in the curriculum offered by other programs and one 3-credit MOOCs of 30 hours or 6 weeks duration in addition to a project of 8-credit leading to design, process development, system component design & fabrication and application development relevant to the chosen field of interest prescribed in the curriculum.

16. **Academic Bank of Credits:** This academic regulation 2023 provides complete scope of academic flexibility in accordance with The Gazette of India, the notification issued by UGC pertaining to the Academic Bank of Credits (ABC) vide File No. 14-31/2018 (CPP – II) dated 28th July, 2021, New Delhi. The ABC provides a full length academic flexibility while removing rigid curriculum boundaries and creating new possibilities of life-long learning.

Incase with students registering under ABC, it is very much mandate and recommended to complete the courses pertaining to professional core and the courses at the lower semesters, especially, the courses pertaining to Mathematics, Physics, Chemistry and few related to Engineering Sciences. Further, the students opting for industry connect courses can be accumulated, transferred and redeemed for the award of B. Tech (Regular) degree alone and courses in the curriculum other than the category of Basic Sciences, Engineering Sciences and Professional Core can be compensated.

17. **Temporary Break of Study from the Program:** The curriculum provides flexibility for the students having ≥9 CGPA to take a break of one year at any time after the end of I/II/III year of study to pursue entrepreneurship on full time. This period of gap shall be counted for the maximum time of graduation. A committee approved by the Academic Council shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the break of study.

18. **Revision of the Academic Regulations and Curriculum**

The Joint Board Committee and the Academic Council of the institute reserve the right to revise, change or amend the regulations, the scheme of examinations, the curriculum and the syllabi from time to time if found necessary.

19. **Representation of Special Cases**

In case of any clarification in the interpretation of the above rules and regulations, they shall be referred to the Joint Board Committee through the Head of the Institution. The Joint Board Committee will offer suitable interpretations/ clarifications /amendments required for special case on such references and get them ratified in the next meeting of the Academic Council. The decision of the Academic Council is final.

20. **Curriculum and Syllabi of various Programs of Study (Scan to view the Program Curriculum and Syllabi)**

Computer Science and Engineering

Preamble: The curriculum of B. Tech (Computer Science and Engineering) program offered by the Department of Computer Science and Engineering under Academic Regulation 2020 is prepared in accordance with the curriculum framework of AICTE, UGC and Andhra Pradesh State Council of Higher Education (APSCHE). Further this Outcome Based Curriculum (OBC) is designed with Choice Based Credit and Semester System (CBCSS) enabling the learners to gain professional competency with multi-disciplinary approach catering the minimum requirement (Program Specific Criteria) of Lead Societies like ACM and other Professional Bodies as per the Engineering Accreditation Commission (EAC) of ABET and NBA. In addition, the curriculum and syllabi are designed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Professional Bodies, Research Organizations and Parents to capture their voice of the respective stakeholders.

The Curriculum design, delivery, and assessment, the three major pillars of academic system is completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes to facilitate the learners to achieve their Professional and Career Accomplishments.

The Vision

To become the Centre of Excellence for technically competent and innovative computer engineers

The Mission

- To provide quality education and spread professional & technical knowledge, leading to a career as computer professionals in different domains of industry, governance, and academia
- To provide state-of-the-art environment for learning and practices
- To impart hands on training in latest methodologies and technologies

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Program Educational Objectives (PEOs)

The PEOs are the educational goals that reflect Professional and Career Accomplishments that a graduate should attain after 4 – 5 years of his/her graduation.

The graduates of Computer Science and Engineering of NSRIT will

1. Exhibit new age talents that use critical thinking and problem-solving skills in the rapidly changing tech landscape demands dynamism in addition to the application of fundamental and conceptual knowledge meeting client business requirements
2. Sustain their satisfactory professional career in their own start-ups or as a team member/team lead in an IT or allied industry
3. Engage in self-directed learning and advanced studies based on the demand driven need of the industries for their professional and career accomplishments

Program Outcomes (POs)

The POs are the transactional statements of graduate attributes (GAs) that each graduating engineer should possess in terms of knowledge, skill and behavior with a minimum target performance level at the time of graduation as fixed by the program of study seeking continuous improvement year on year.

The graduates of Computer Science and Engineering of NSRIT will be able to demonstrate the following outcomes in terms knowledge, skill and behavioral competencies at the time of graduation with the expected target performance level

1. Apply the knowledge of basic sciences and fundamental engineering concepts in solving engineering problems (Engineering Knowledge)
2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences (Problem Analysis)
3. 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 (Design/Development of Solutions)
4. Perform investigations, design and conduct experiments, analyse and interpret the results to provide valid conclusions (Investigation of Complex Problems)
5. Select/develop and apply appropriate techniques and IT tools for the design & analysis of the systems (Modern Tool Usage)
6. Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practices (The Engineer and Society)
7. Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development (The Environment and Sustainability)
8. Demonstrate Knowledge of professional and ethical practices (Ethics)
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations (Individual and Team Work)
10. Communicate effectively among engineering community, being able to comprehend and write effectively reports, presentation and give / receive clears instructions (Communication)
11. Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment (Project Finance and Management)
12. Recognize the need for, and have the ability to engage in independent and lifelong learning (Life Long Learning)

Program Specific Outcomes (PSOs)

1. Able to apply the theoretical knowledge of Computer Science and Engineering and the foundational principles of software development to provide sustainable solutions for the real world technical challenges in the tech landscape by maintaining professional standards, ethical values and integrity
2. Able to adopt to technological changes by initiating self-paced learning to meet the industry demands

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II

List of Honors offered by Computer Science & Engineering Program

1. High Performance Computing
2. Data Analytics
3. Game Programming

List of Minor with Specialization offered by Computer Science & Engineering Program

1.   Database Engineering

Category-wise Credit Distribution of Courses

	Category	AICTE	APSCHE	NSRIT (A)
HS	Humanities and Social Science	12.0	10.5	10.5
BS	Basic Science	25.0	18.0	18.0
ES	Engineering Science	24.0	22.5	19.5
PC	Professional Core	48.0	55.5	58.5
PE	Professional Elective	18.0	15.0	15.0
OE	Open Elective	18.0	12.0	12.0
IN	Internship (s), Project & Seminars	15.0	16.5	16.5
SC	Skill Oriented Courses	-	10.0	10.0
MC	Mandatory Courses	-	-	-
AC	Audit Course	-	-	-
	Total no. of credits	160	160	160

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Computer Science and Engineering

Credit requirement for the award of the degree under academic Regulation 2020–2021 for the candidates admitted from the academic year 2021 onwards

	Four Years	Three Years
B. Tech.(Regular Degree)	160	121
B. Tech.(Honors Degree)	180	141
B. Tech.(With Minor specialization other than Chosen Branch of Engg.& Tech.)	180	141

Semester I

No.	Code	Course	POs	L	T[1]	P	C	
01	20HSX01	Communicative English	10	3	0	0	3.0	HS
02	20BSX11	Linear Algebra and Differential Equations	1, 12[2]	3	1	0	3.0	BS
03	20BSX33	Applied Physics	1	3	1	0	3.0	BS
04	20ESX02	Programming for Problem Solving using 'C'	1	3	0	0	3.0	ES
05	20CS101	Fundamentals of Computer Science	1	3	0	0	3.0	ES
06	20HSX02	Communicative English Lab	1, 10	0	0	3	1.5	HS
07	20BSX34	Applied Physics Lab	1, 4	0	0	3	1.5	BS
08	20ESX07	Programming for Problem Solving using 'C' Lab	1, 4	0	0	3	1.5	ES
			Sub-total	15	02	09	19.5	

Semester II

No.	Code	Course	POs	L	T[1]	P	C	
01	20BSX12	Partial Differential Equations and Vector Calculus	1	3	1	0	3.0	BS
02	20BSX23	Applied Chemistry	1	3	1	0	3.0	BS
03	20ESX05	Basic Electrical and Electronics Engineering	1	3	1	0	3.0	ES
04	20CS201	Data Structures using 'C'	1	3	1	0	3.0	ES
05	20EC203	Digital Logic Design	1	3	1	0	3.0	ES
06	20BSX24	Applied Chemistry Lab	1, 4	0	0	3	1.5	BS
07	20CS202	Data Structures using 'C' Lab	1, 4	0	0	3	1.5	ES
08	20ESX08	Basic Electrical & Electronics Engineering Lab	1, 4	0	0	3	1.5	ES
09	20MCX01	Environmental Science	-	2	0	0	-	MC
			Sub-total	17	05	09	19.5	

Semester III

No.	Code	Course	POs	L	T[1]	P	C	
01	20BSX16	Mathematical Foundations for Computer Science	1	3	1	0	3.0	BS
02	20CS302	Design and Analysis of Algorithms	1, 2, 3	3	1	0	3.0	PC
03	20CS303	Database Management Systems	1, PSO1	3	1	0	3.0	PC
04	20CS304	Object Oriented Programming through C++	1	3	1	0	3.0	PC
05	20CS305	Computer Organization	1	3	0	0	3.0	PC
06	20CS306	Design and Analysis of Algorithms Lab	4	0	0	3	1.5	PC
07	20CS307	Database Management Systems Lab	1, 4, PSO1	0	0	3	1.5	PC
08	20CS308	Object Oriented Programming through C++Lab	1, 4	0	0	3	1.5	PC
09	20CSS01	Short-term Skill Oriented Elective	3, 4, 5	0	0	4	2.0	SC
10	20MCX02	Constitution of India[3]	-	2	0	0	-	MC
			Sub-total	17	05	09	21.5	

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[1]Suggested tutorial hours will not carry any credits

[2]By default, all courses are mapped to PO 12 as they are weakly contributing

[3]It is mandate for all students to pursue an online certification course for minimum duration of 30 hours

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Semester IV

No.	Code	Course	POs	L	T	P	C	
01	20HSX03	Managerial Economics & Financial Analysis	11	3	0	0	3.0	HS
02	20CS402	Data Warehousing and Mining	1, 2	3	0	0	3.0	PC
03	20CS403	Python Programming	1	3	1	0	3.0	PC
04	20CS404	Operating Systems	1	3	1	0	3.0	PC
05	20CS405	Theory of Computation	1, 2	3	1	0	3.0	PC
06	20CS406	Data Mining Lab	4	0	0	3	1.5	PC
07	20CS407	Python Programming Lab	4	0	0	3	1.5	PC
08	20CS408	Operating Systems Lab	1, 4	0	0	3	1.5	PC
09	20CSS02	Short-term Skill Oriented Elective	3, 4, 5	0	0	4	2.0	SC
			Sub-total	16	03	11	21.5	

Semester V

No.	Code	Course	POs	L	T	P	C	
01	20CS501	Java Programming	1	3	1	0	3.0	PC
02	20CS502	Computer Networks	1, 2	3	1	0	3.0	PC
03	20AI405	Artificial Intelligence	1,2	3	1	0	3.0	PC
04	-	Professional Elective I	-	3	0	0	3.0	PE
05	-	Open Elective I	-	3	0	0	3.0	OE
06	20CS506	Java Programming Lab	4	0	0	3	1.5	PC
07	20CS507	Computer Networks Lab	1, 4	0	0	3	1.5	PC
08	-	Technical Paper Writing[4]	1, 10	0	0	4	2.0	SC
09	20MCX03	Intellectual Property Rights and Patents[5]	-	2	0	0	-	MC
10	-	SummerInternship#1[6] / CSP	5, 8, 9, 10, PSO1	0	0	0	1.5	IN
			Sub-total	17	03	08	21.5	

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[4]The students are expected to identify one research area in the recent trends, collect recent research articles, prepare a technical research review paper and publish in renowned annual conferences/ journals, preferably indexed in Scopus or UGC care

[5]It is mandate for all students to pursue an online certification course for minimum duration of 30 hours

[6]The work pertaining to summer Internship #1 and #2 shall be completed at the end of the semesters IV & VI respectively. The assessment shall be carried out during the semesters V and VII

It is mandate for all the students to undergo 4-6 weeks of industrial training and appear for assessment during Semester V with report. With regard to Community Service Project (CSP), based on the availability the students can opt CSP as an alternate option for summer internship #1 for a duration of 08 weeks

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Semester VI

No	Code	Course		L	T	P	C	Cat
01	20CS601	Cryptography and Network Security	1, 2, 3	3	0	0	3.0	PC
02	20CS602	Web Technologies	1, 2, 3	3	0	0	3.0	PC
03	20CS603	Modern Software Engineering	1, 2, 3	3	0	0	3.0	PC
04	-	Professional Elective II	-	3	0	0	3.0	PE
05	-	Open Elective II	-	3	0	0	3.0	OE
06	20CS606	Cryptography and Network Security Lab	4	0	0	3	1.5	PC
07	20CS607	Web Technologies Lab	4	0	0	3	1.5	PC
08	20CS608	Modern Software Engineering Lab	4	0	0	3	1.5	PC
09	20CSS04	Short-term Skill Oriented Elective	5, PSO1, PSO2	0	0	4	2.0	SC
10	20MCX04	Indian Traditional Knowledge[7]	-	0	0	0	-	MC
		Sub-total		17	03	13	**21.5**	

Semester VII

No	Code	Course		L	T	P	C	Cat
01	-	Professional Elective III		3	0	0	3.0	PE
02	-	Professional Elective IV		3	0	0	3.0	PE
03	-	Professional Elective V		3	0	0	3.0	PE
04	-	Open Elective III		2	0	2	3.0	OE
05	-	Open Elective IV		2	0	2	3.0	OE
06	20HSX04	Professional Ethics	8	3	0	0	3.0	HS
07	20CSS05	Finishing School for CSE	PO1~PO12	0	0	4	2.0	SC
08	-	Summer Internship#2[8]	All POs, PSOs	0	0	0	3.0	IN
		Sub-total		16	0	04	**23.0**	

Semester VIII

No	Code	Course		L	T	P	C	Cat
01	-	Full Semester Internship[9]	5 – 10, PSOs	0	0	0	06	IN
02	-	Capstone Project	5 – 10, PSOs	0	0	0	06	IN
		Sub-total		0	0	0	**12.0**	
		Total Credits		-	-	-	**160**	

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[7]It is mandate for all the students to pursue an online certification course for minimum duration of 30 hours

[8]It is mandate for all the students to undergo 6-8 weeks of industrial training and appear for assessment during Semester VII write report and those opted FSI during Semester VII shall appear through online for reviews

[9]Students opting for FSI in VII semester have to take up courses of VII semester in VIII semester. The students are expected to do a capstone project parallelly demonstrating their POs & PSOs and submit a separate report

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VI

List of Electives

ProfessionalElective#1

#	Code	Title		L	T	P	C	
1	20CS001	Object Oriented Analysis and Design	-	3	0	0	3.0	PE
2	20BSX15	Probability and Statistics	-	3	0	0	3.0	PE
3	20AI603	Artificial Neural Networks	-	3	0	0	3.0	PE
4	20CS004	Internet of Things	-	3	0	0	3.0	PE
5	20CS005	Mobile Computing	-	3	0	0	3.0	PE

ProfessionalElective#2

#	Code	Title		L	T	P	C	
6	20CS006	Software Quality Management	-	3	0	0	3.0	PE
7	20DS405	Foundations of Data Science	-	3	0	0	3.0	PE
8	20AI502	Machine Learning	-	3	0	0	3.0	PE
9	20CS009	Network Programming and Protocols	-	3	0	0	3.0	PE
10	20CS010	Cloud Computing	-	3	0	0	3.0	PE

ProfessionalElective#3

#	Code	Title		L	T	P	C	
11	20CS011	Software Testing Methodologies	-	3	0	0	3.0	PE
12	20DS502	Big Data	-	3	0	0	3.0	PE
13	20AI602	Deep Learning Principles and Practices	-	3	0	0	3.0	PE
14	20CS014	Block Chain Technologies	-	3	0	0	3.0	PE
15	20CS015	XML and Web Services	-	3	0	0	3.0	PE

ProfessionalElective#4

#	Code	Title		L	T	P	C	
16	20CS016	Software Project Management	-	3	0	0	3.0	PE
17	20DS603	Data Visualization	-	3	0	0	3.0	PE
18	20AI005	Cyber Security	-	3	0	0	3.0	PE
19	20CS019	Ethical Hacking	-	3	0	0	3.0	PE
20	20DS020	Digital Image Processing and Applications	-	3	0	0	3.0	PE

ProfessionalElective#5

The curriculum provides academic flexibility to choose any of the domain specific courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self study mode. The course shall be of 45–60 hours duration (4 credits) and the assessment shall be as per the academic regulation 2020. **PE**

Open Elective #1

#	Code	Title		L	T	P	C	
21	20CEO01	Urban Environmental Services	-	3	0	0	3.0	OE
22	20CSO01	Data Structures and Algorithms	-	3	0	0	3.0	OE
23	20AIO01	Machine Learning for Engineers	-	3	0	0	3.0	OE
24	20DSO01	Introduction to Database Management Systems	-	3	0	0	3.0	OE
25	20ECO01	Architecture and Algorithms of IoT	-	3	0	0	3.0	OE
26	20EEO01	Introduction to Renewable Energy Sources	-	3	0	0	3.0	OE
27	20MEO01	Nano Technology	-	3	0	0	3.0	OE
28	20SHO01	Women and Society	-	3	0	0	3.0	OE

Open Elective #2

#	Code	Title		L	T	P	C	
29	20CEO02	Ecology, Environment and Resource Management	-	3	0	0	3.0	OE
30	20CSO02	Designing the Internet of Things	-	3	0	0	3.0	OE
31	20AIO02	Fundamentals of Deep Learning	-	3	0	0	3.0	OE
32	20DSO02	Introduction to Data Science	-	3	0	0	3.0	OE
33	20ECO02	IoT for Smart Grids	-	3	0	0	3.0	OE
34	20EEO02	Electrical Safety and Management	-	3	0	0	3.0	OE
35	20MEO02	Fundamentals of Automobile Engineering	-	3	0	0	3.0	OE

Open Elective #3

#	Code	Title		L	T	P	C	
36	20CEO03	Disaster, Risk Mitigation and Management	-	3	0	0	3.0	OE
37	20CS404	Operating Systems	-	3	0	0	3.0	OE
38	20AIO03	Fundamentals of AI	-	3	0	0	3.0	OE
39	20DSO03	Introduction to Big Data	-	3	0	0	3.0	OE
40	20ECO03	Privacy and Security in IoT	-	3	0	0	3.0	OE
41	20EEO03	Low-cost Automation	-	3	0	0	3.0	OE
42	20MEO03	Industrial Automation	-	3	0	0	3.0	OE
43	20SHO02	Design Thinking	-	3	0	0	3.0	OE

Open Elective #4

The curriculum provides academic flexibility to choose any of the inter-disciplinary courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration and the assessment shall be as per the academic **OE**

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regulation 2020

B. Tech. (Honors)
Category I

				L	T	P	C	
1	20CSH01	Advanced Computer Architecture	-	4	0	0	4.0	HO
2	20DSH01	Text Analytics	-	4	0	0	4.0	HO
3	20AIH03	Game Theory	-	4	0	0	4.0	HO

Category II

4	20CSH04	GPU Architecture and Programming	-	4	0	0	4.0	HO
5	20DSH04	Recommender Systems	-	4	0	0	4.0	HO
6	20AIH06	Game Programming	-	4	0	0	4.0	HO

Category III

7	20CSH07	Fault Tolerant Computing	-	4	0	0	4.0	HO
8	20DSH07	Data Analysis with Matlab	-	4	0	0	4.0	HO
9	20AIH09	3D Graphics and Animation	-	4	0	0	4.0	HO

Category IV

10	20CSH10	Distributed and Parallel Computing	-	4	0	0	4.0	HO
11	20DSH10	Data Preparation and Cleaning	-	4	0	0	4.0	HO
12	20AIH12	Augmented Reality and Virtual Reality	-	4	0	0	4.0	HO

B. Tech. (Minor with Specialization)
Category I

1	20CEM01	Air Pollution	-	3	0	0	3.0	MI
2	20CSM01	E-Commerce	-	3	0	0	3.0	MI
3	20MEM01	Biomaterials	-	3	0	0	3.0	MI
4	20EEM01	Basic Control Systems	-	3	0	0	3.0	MI
5	20ECM01	Semiconductor Devices & Circuits	-	3	0	0	3.0	MI
6	20AIM01	Fundamentals of Neural Networks	-	3	0	0	3.0	MI
7	20DSO03	Introduction to R Programming	-	3	0	0	3.0	MI
8	20SHM01	Psychology	-	3	0	0	3.0	MI
9	20SHM02	Statistical Methods	-	3	0	0	3.0	MI
10	20MBM01	General Management	-	3	0	0	3.0	MI
11	20MBM02	Human Resource Planning	-	3	0	0	3.0	MI

Category II

12	20CEM02	Climate Change Mitigation and Adaptation	-	3	0	0	3.0	MI
13	20CSM02	Knowledge Discovery and Databases	-	3	0	0	3.0	MI
14	20MEM02	Micro Electromechanical Systems	-	3	0	0	3.0	MI
15	20EEM02	Basics of Electrical Machines and Drives	-	3	0	0	3.0	MI
16	20ECM02	Digital Electronics	-	3	0	0	3.0	MI
17	20AIM02	Machine Learning with Python	-	3	0	0	3.0	MI
18	20DSM02	Data Management and Analysis	-	3	0	0	3.0	MI
19	20SHM03	English for Media	-	3	0	0	3.0	MI
20	20SHM04	Statistical Inference	-	3	0	0	3.0	MI
21	20MBM03	Organizational Behavior	-	3	0	0	3.0	MI
22	20MBM04	Compensation Management & Employee Welfare Laws	-	3	0	0	3.0	MI

Category III

23	20CEM03	Sustainability and Pollution Prevention Practices	-	3	0	0	3.0	MI
24	20CSM03	Database Security	-	3	0	0	3.0	MI
25	20MEM03	Surface Engineering	-	3	0	0	3.0	MI
26	20EEM03	Electrical Engineering Material Science	-	3	0	0	3.0	MI
27	20ECM03	Analog Electronic Circuits	-	3	0	0	3.0	MI
28	20AIM03	Interpretable Machine Learning	-	3	0	0	3.0	MI
29	20DSM03	Data Governance	-	3	0	0	3.0	MI
30	20SHM05	Journalism	-	3	0	0	3.0	MI
31	20SHM06	Statistical Quality Control	-	3	0	0	3.0	MI
32	20MBM05	Entrepreneurship and Business Venture Planning	-	3	0	0	3.0	MI
33	20MBM06	Performance Management and Talent Management	-	3	0	0	3.0	MI

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Short Term Skill Oriented Electives

34	23CSS01	Programming Basics	3, 4, 5	0	0	4	2.0	SC
35	23CSS02	Competitive Programming Essentials	3, 4, 5	0	0	4	2.0	SC
36	23CSS04	Android App Development	5, PSO1, PSO2	0	0	4	2.0	SC

Industry Connect Courses (Skill Oriented Courses)[10]

37	20ICC01	Competitive Programming	-	2	0	8	6.0	ICC
38	20ICC02	Web Technologies – Transferring to Practice	-	2	0	8	6.0	ICC
39	20ICC03	Java and Spring boot	-	2	0	8	6.0	ICC
40	20ICC04	Robotics Process Automation	-	2	0	8	6.0	ICC
41	20ICC05	Information Security and Forensics	-	2	0	8	6.0	ICC
42	20ICC06	Battery System – Design Engineering	-	2	0	8	6.0	ICC
43	20ICC07	Blockchain Technology	-	2	0	8	6.0	ICC
44	20ICC08	Network Administration	-	2	0	8	6.0	ICC
45	20ICC09	Product Engineering	-	2	0	14	9.0	ICC
46	20ICC10	Machine Learning Engineer	-	2	0	8	6.0	ICC
47	20ICC11	Data Scientist	-	2	0	8	6.0	ICC
48	20ICC12	Industrial IoT	-	2	0	8	6.0	ICC

List of Honors offered by Computer Science & Engineering Program
1. High Performance Computing
2. Data Analytics
3. Game Programming

List of Minor with Specialization offered by Computer Science & Engineering Program
1. Database Engineering

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[10]The credits earned through Industry Connect Courses (Skill Oriented Course) can be tradeoff with any other 3-Credit course other than Professional Core

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| BS | 20BSX16 Mathematical Foundations of Computer Science | | 3 | 1 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX16.1	Construct and Verify the Correctness of Statements using Propositional and Predicate Logic	3	1	L1, L2, L3
20BSX16.2	Illustrate the Operations on Discrete Structures such as Relations and Functions	3	1	L1, L2
20BSX16.3	Interpret the concepts of divisibility, prime number, congruence and number theorems	3	1	L1, L2, L3
20BSX16.4	Solve Recurrence Relations and Generating Functions	3	1	L1, L2, L3
20BSX16.5	Demonstrate Graphs and Trees as Tools to Visualize and Simplify Situations	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Mathematical Logic   11 + 1 Hour
Propositional Calculus: Statements and Notations -Connectives - Well-formed Formulas - Truth Tables - Tautology – Equivalence Implication- principal disjunctive and conjunctive normal forms, Rules of Inference for Statement Logic - Proof Techniques - Proof by Contradiction.
Predicate Calculus: Predicative logic, free & bound variables, quantifiers, rules of inference.

Disjunctive and Conjunctive normal forms

Unit II: Binary Relations, Functions and Algebraic Structures   11 + 1 Hour
Binary Relations - Properties and Operations - Relational Graphs - Relation Matrices – Equivalence Relations - Partial Ordering Relations - Hasse Diagram.
Functions – Types of functions - Composition of Functions-Permutation and Recursive Functions.
Algebraic Structures (Definitions and simple illustrations) - Semi Groups – Monoids – Groups - Abelian Groups – Subgroups.

Algebraic Structures (Definitions and simple illustrations), Inverse functions

Unit III: Number Theory   11 + 1 Hour
Properties of integers, divisibility, Division theorem, Greatest Common Divisor (GCD), Euclidean algorithm, Least Common Multiple (LCM), testing for prime numbers, The Fundamental theorem of arithmetic, modular arithmetic: Congruence, congruence equations, Fermat's Theorem, Euler's Totient function, Euler's theorem, Chinese Remainder theorem.

Chinese Remainder theorem

Unit IV: Recurrence Relations   11 + 1 Hour
Generating Functions - Function of Sequences -Calculating Coefficient of Generating Functions.
Recurrence Relations - Solving Recurrence Relation by Substitution- solving homogeneous linear recurrence relations by characteristic roots method- non homogeneous linear recurrence relations

Applications: Algorithm Analysis - Time and Space Complexity

Unit V: Graph Theory (All theorems without proof)   11 + 1 Hour
Basic Concepts - Graph Theory- Sub graphs- Graph Representations- Adjacency and Incidence Matrices - Isomorphic Graphs- Paths and Circuits, Eulerian and Hamiltonian Graphs, planar graphs, spanning trees minimal spanning tree.

Operations on Graphs

Text Books

1. Kenneth H. Rosen, "Discrete Mathematics and Applications", 7ᵗʰ Edition, Tata McGraw Hill, 2015

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2. Mott J. L, Kandel A and Baker T. P., Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Prentice Hall , India, 2010
3. Santha S., Prasad E. V., "Mathematical Foundation for computer Science" 1st Edition, Cengage, 2017

Reference Books

1. Liu C. L. and Mohapatra D. P., "Elements of Discrete Mathematics, A Computer Oriented Approach", 4th Edition, Tata McGraw Hill, 2018
2. Tremblay J. P. and Manohar P., "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, 2nd Edition, 1997
3. Swapan Kumar Sarkar, "A text book of Discrete Mathematics", S. Chand Publications, 7th Edition, 2018

Web References

1. https://nptel.ac.in/courses/106106094/
2. https://nptel.ac.in/courses/111/101/111101137/
3. http://www.saylor.org/course/cs202/
4. http://www.cse.iitd.ernet.in/~bagchi/courses/discrete-book

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	40	40
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define converse, contra positive and inverse of an implication
2. Write a note on   operator in modular arithmetic
3. Define Binary Relation
4. Define prime and co-prime numbers
5. A complete binary tree has 125 edges. How many vertices does it have?

L2: Understand

1. Show that the $(\sim P \quad P \quad Q)) \quad (\sim Q)$ statement is a tautology
2. Given R = {(1, 1), (1, 4), (4, 1), (2, 2), (2, 3), (3, 4), (3, 3), (3, 2), (4, 3),(4, 4)}. Verify the relation R on X = {1, 2, 3, 4} is an equivalence relation or not
3. Explain different tests for primality.
4. Solve $a_n - 6a_{n-1} + 9a_{n-2} = 0$ for n>=2 given $a_0=5, a_1=12$
5. Explain minimal spanning tree of the graph with suitable example

L3: Apply

1. Find GCD of 330,616 using Euclidian algorithm
2. Solve the recurrence relation $a_n - 7 a_{n-1} + 10 a_{n-2} = 0$ for n   2 using generating functions
3. Let G be the set of all non-zero real numbers with a binary operation *, defined as $a*b = a^2b^2$. Show that <G,*> is an abelian group
4. Show that the complete graphs K_2, K_3, K_4 are planar
5. Find the last two digits of 3333^{4444}

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PC 20CS302 Design and Analysis of Algorithms   3 1 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PO12	
20CS302.1	Describe the process of analysing the performance of any algorithm	3	1	1	1	L1, L2
20CS302.2	Classify the time complexity of any algorithm to appropriate asymptotic class after computing its complexity	3	1	1	1	L1, L2
20CS302.3	Explain the general principle of different algorithm design strategies	3	1	1	1	L1, L2, L3
20CS302.4	Design algorithms for given computing problem by choosing appropriate design strategy	3	1	1	1	L1, L2, L3
20CS302.5	Calculate the performance of any algorithm designed to solve given computing problem	3	1	1	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to algorithms   9 + 3 hours
Fundamentals of algorithmic problem solving – Fundamentals of the analysis of algorithm efficiency: Analysis framework – Asymptotic notations and basic efficiency classes – Mathematical analysis of non-recursive algorithms – Mathematical analysis of recursive algorithms – Empirical analysis of algorithms – Brute Force Strategy: Bubble sort, Sequential search, String matching problem – Exhaustive Search Strategy: Knapsack problem

Depth First Search, Breadth First Search

Unit II: Algorithm Design Techniques I   12 + 3 hours
Decrease and Conquer: General method, Insertion sort, Topological Sorting, Algorithm to generate combinatorial objects – Decrease by constant factor and variable size decrease – Divide and Conquer: General method, Merge sort, Quick sort, Multiplication of large integers, Strassen's matrix multiplication – Transform and Conquer: General method, Pre-sorting, Heaps and Heapsort

Balanced search trees

Unit III: Algorithm Design Techniques II   12 + 3 hours
Greedy Technique: General method, Knapsack problem, Job sequencing with deadlines, Minimal cost spanning tree algorithms (Prim's and Kruskal's), Optimal merge pattern, Single source shortest path algorithm, Huffman trees and codes – Dynamic Programming: General method, 0/1 knapsack problem, All pair shortest path algorithm

Optimal Binary Search trees

Unit IV: Limitations of Algorithmic power   6 + 2 hours
P, NP, NP – hard and NP-complete problems – Basic concepts, NP – hard graph problems, Cook's theorem

Simplified NP – hard problems

Unit V: Coping up with limitations of algorithmic power   8 + 2 hours
Backtracking: General method, N-queen's problem, Subset sum problem, Hamiltonian circuit problem, Graph coloring problem - Branch and Bound: General method, Least Cost (LC) search, Control abstractions for LC search, Bounding, FIFO based branch and bound, LC based branch and bound, Traveling Salesman problem, Assignment problem

0/1 knapsack problem

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Text Books

1. Anany Levitin, "Introduction to The Design and Analysis of Algorithms", Third Edition, Pearson Education, 2017
2. Ellis Horowitz, SatrajSahni and Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, University Press, 2007
3. T.H. Cormen., C.E. Leiserson,R.L.Rivest., C.Stein, "Introductionton Algorithms", Third Edition, MIT Press, 2009

Reference Books

1. Aho, Ullman and Hopcroft, "Design and Analysis of Computer Algorithms", First Edition, Pearson Education, 2002
2. Richard Johnson Baugh., Marcus Schaefer, "Algorithms", First Edition, Pearson Education, 2013

Web Resources

1. www.geeksforgeeks.com
2. www.sanfoundary.com
3. www.topcoder.com

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

L1: Remembering

1. Define algorithm
2. List the four properties of a good algorithm
3. Define time complexity and space complexity
4. What are asymptotic classes?
5. Define the principle of optimality
6. State Cook's theorem
7. Define minimal spanning tree
8. Define NP hard and NP complete problems

L2: Understanding

1. What do you mean by order of growth of an algorithm?
2. Write all the basic asymptotic classes in increasing order of their efficiency
3. Explain the general method of greedy technique
4. Describe the general method of dynamic programming strategy
5. Describe the working of backtracking algorithm
6. Exemplify decrease and conquer algorithm with appropriate example

L3: Applying

1. Design a recursive algorithm to find the sum of first n integers and compute its time and space complexity
2. Write the quick sort algorithm by applying divide and conquer strategy and compute it complexity
3. Assume a list of integers which are in increasing order. Compare the time complexity of quick sort and merge sort algorithms in terms of number of swaps performed
4. Design an algorithm based on dynamic programming to find the product of a chain of matrices
5. Solve 0/1 knapsack problem using branch bound technique

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4

| PC | 20CS303 Database Management Systems | | | 3 | 1 | 0 | 3.0 |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | DoK |
		PO1	PO12	PSO1	
20CS303.1	Describe the basic concepts of databases and data models	3	1	2	L1, L2
20CS303.2	Illustrate the principles of relational data model	3	1	2	L1, L2, L3
20CS303.3	Apply SQL commands to work with databases	3	1	1	L1, L2, L3
20CS303.4	Apply the principles of database normalization	3	1	2	L1, L2, L3
20CS303.5	Describe the transaction management strategies and recovery systems	3	1	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction to Databases
9 + 3 Hours

Overview of Data Base Systems, Database System Applications, File System VS Database System, Data Abstraction, Levels of Abstraction, Data Independence Instances and Schemas, Different Data Models, Database Languages, Data Base Users and Administrator, Database System Structure, N-tier Architecture, Database design and ER diagrams, Design Entities, Attributes and Entity sets, Relationships and Relationship Sets, Advanced Features of ER Model, Conceptual Design for Large enterprises

History of DBMS

Unit II: Relational Model, Relational Algebra and Relational calculus
9 + 3 Hours

Relational Model: Introduction to the Relational Model, Integrity Constraint and key constraints over relations, Logical data base Design, Views, Destroying / Altering Tables and Views - Relational Algebra: Selection and Projection, Set Operations, Aggregate Operations, Renaming, Joins, Division, Additional Relational Algebraic operations - Relational calculus: Tuple Relational Calculus, Domain Relational Calculus

Expressive Power of Algebra and Calculus

Unit III: Structured Query Language
9 + 3 Hours

SQL: Concept of different Database Languages over SQL - DDL, DML, DCL., Set operations, SQL Commands, Nested queries, Aggregate Functions, Null Value, Referential Integrity Constraints, views, Embedded SQL, Triggers, Cursors, Stored procedures, ODBC and JDBC.

Compare all Database Languages, Importance of Null values

Unit IV: Schema Refinement and Normalization
9 + 3 Hours

Undesirable Properties in Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure Set of Functional Dependencies, Closure Set of Attributes. - Normalization: 1NF, 2NF, 3NF, BCNF, Lossless Join and Dependency Preserving decomposition, 4NF and 5NF- Indexing: Basic Concepts, Primary Index, Dense and Sparse Indices, Secondary Indices, Trees, Structured Indexing, Indexed Sequential Access Method (ISAM)

Compare all Normal Forms

Unit V: Transaction Management and Recovery System
9 + 3 Hours

Transaction Management and Concurrency Control: Transaction Concept, ACID Properties, States of Transaction, Implementation of Atomicity & Durability, Schedules, Testing of Serializability, 2PL, Serializability and Recoverability, Introduction to Lock Management, Lock Conversions, Specialized Locking Techniques - Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery, Recovery with Concurrent Transactions, Buffer Management, Failure with Loss of Non-volatile Storage, ARIES Recovery Method, Remote Backup Systems.

Concurrency Control without Locking

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Scnivar,

Text Books

1. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", Third Edition, TATA McGraw Hill, 2008
2. Abraham Silber Schatz, Henry F Korth, S Sudarshan, "Database System Concepts", Sixth Edition, McGraw-Hill International Edition, 2013
3. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006

Reference Books

1. Elmasri Navrate, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016
2. Peter Rob & Carlos Coronel, "Data base Systems design, Implementation, and Management", Tenth Edition, Pearson Education, 2013

Web References

1. http://www.nptelvideos.in/2012/11/database-managementsystem.html
2. https://www.javatpoint.com/dbms-tutorial

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	30	40
L3	40	30
Total (%)	100	100

L1: Remember

1. List all the types of database users
2. List out all the different types of data models present
3. Give syntaxes to Create and Alter a table
4. What is Redundancy?
5. List out the properties of transactions

L2: Understand

1. Compare the database system with conventional file system
2. Demonstrate the use of DISTINCT keyword in SQL select statement
3. Explain the following SQL constructs with examples:
   (1) Order by (2) group by and having (3) as select (4) schema
4. Explain the difference among Entity, Entity Type & Entity Set
5. Illustrate different types of joins in SQL

L3: Apply

1. Choose a relation R with 5 attributes ABCDE and the following FDs: A ->B, BC->E, and ED ->A. Is R in 3NF? Justify?
2. Apply Normalization technique for the following relation up to 3NF:
   Bank (acno, cust_name, ac_type, bal, int_rate, cust_city, branchId, branch_nm, br_city)
3. Construct a transaction state diagram and describe each state that a transaction goes through during its execution?
4. Utilize the following database schema to write queries in SQL
   Sailor (sid, sname, age, rating)
   Boats (bid, bname, bcolor)
   Reserves (Sid, bid, day)
   i) Find the sailors who have reserved a red boat
   ii) Find the names of the sailors who have reserved at least two boats
   iii) Find the colors of the boats reserved by 'Mohan'?
5. By considering relevant example, show insertion and deletion operations on a B-Tree.

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| PC | 20CS304 Object Oriented Programming through C++ | 3 | 1 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20CS304.1	Articulate the principles of object-oriented problem solving and programming	3	1	L1, L2
20CS304.2	Explain dynamic memory management techniques	3	1	L1, L2
20CS304.3	Illustrate the concept of function overloading, operator overloading	3	1	L1, L2, L3
20CS304.4	Demonstrate the use of virtual functions and exception handling	3	1	L1, L2, L3
20CS304.5	Demonstrate generic programming and templates	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Object Oriented Programming
9 +3 hours

The Object Oriented Technology, difference between Procedural Oriented Programming and object oriented programming, advantage of OOP, Principles of object oriented programming. Introduction to C++: Evolution of C++, I/O stream classes in C++, Unformatted and Formatted Console I/O Operations, Manipulators, Data Types, Reference Variables, Namespace. Functions: Introduction, types of arguments, Return statement, Recursion.

Variables, branching and looping statements

Unit II: Classes and Objects
8 + 2 hours

Classes and Objects : classes In C++, declaring objects, dynamic Memory allocation and deallocation, Access specifiers and scope, Member functions, static member variables, Types of member functions, Friend functions, Inline functions, Overloading member functions, Anonymous objects,.

Nested Classes, static member functions

Unit III: Constructors, Operator Overloading and Inheritance
9 +3 hours

Constructors and Destructors: Introduction, characteristic Of constructors and destructors, applications With Constructors, Types of Constructors, overloading constructors, Array of objects Using Constructors. Operator overloading: The keyword operator, rules for overloading operators, overloading unary operator, assignment operator (=), Operator return Type. Inheritance: Introduction, advantages and disadvantages of inheritance, Types of inheritance, Virtual base classes- object as a class member

Constructor and destructor with static members, Overloading binary operator

Unit IV: Polymorphism & Exception Handling
11 +3 hours

Pointers: Pointer, features of pointers, pointer to class, pointer object, this Pointer. Polymorphism: Binding In C++, Static (Early) Binding, Dynamic (Late) binding, Pointer to derived classes and base Class, Virtual Function, Rules for virtual function, Binding polymorphisms and virtual functions, virtual destructor, pure virtual functions, abstract classes. Exception handling: Introduction, Principles of Exception Handling, Exception Handling Mechanism, The keywords try, throw and catch, Multiple catch statements.

Virtual functions in derived classes, Re-throwing exception

Unit V: Generic Programming with Templates
9 +3 hours

Generic programming with templates: Need of Templates, definition of class templates, normal function templates, Sorting using Function Templates, difference between Templates and Macros. Overview of standard template library, STL Programming Model, Containers - Sequence containers, Iterators, Vectors, Lists.

Templates and Inheritance, Associative Containers

Text Books
1. Gary Bronson, "A First Book of C++", Fourth Edition, Cengage Learning, 2012.
2. Herbert Schildt, "The Complete Reference C++", Fifth Edition, TMH, 2012.
3. Ashok N Kamthane, "Programming In C++", Second Edition, Pearson, 2013.

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Reference Books
1. Joyce Farrell, "Object Oriented Programming C++", Fourth Edition,Cengage. 2008.
2. DS Malik ,"C++ Programming: from problem analysis to program design", Sixth Edition, Cengage Learning,2016

Web References
1. https://www.javatpoint.com/cpp
2. https://www.learncpp.com/cpp-tutorial
3. https://www.tutorialspoint.com/cplusplus

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
1. Write any 4 benefits of OOP
2. List all the access specifiers
3. What is overloading?
4. Define the term virtual base class and its implementation.
5. Define function template & Class template
6. What is a Container?
7. List out all types of containers
8. List out member functions from vectors & lists class in STL

L2: Understand
1. Compare all access modes with their scope.
2. Explain types of constructor
3. Explain types of inheritance
4. Demonstrate friend function with example
5. Explain unary and relational operator overloading
6. Explain pure virtual function with example
7. Illustrate Exception Handling Mechanism with using try, throw & catch.

L3: Apply
1. Implement student class to get and print details.
2. Apply the concept of multiple inheritance to read and print employee information
3. Solve to find the area of different shapes using abstract class.
4. Implement any sorting algorithm using templates

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PC **20CS305 Computer Organization**   **3   0   0   3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20CS305.1	Describe the fundamental organization of computer system	3	1	L1, L2
20CS305.2	Explain the concepts of design of basic components of the system	3	1	L1, L2
20CS305.3	Explain the functional units of a processor and addressing modes, instruction format, program control statement	3	1	L1, L2
20CS305.4	Illustrate various algorithms to perform arithmetic operations	3	1	L1, L2
20CS305.5	Distinguish the organization of various parts of system memory hierarchy	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Digital Logic Circuits and Data Representation   **12 Hours**
Digital components: Integrated Circuits, Decoders, Multiplexers, Registers, Shift Registers, Binary Counters, Memory Unit.
Data Representation: Data types, Complements, Fixed Point Representation, Floating – Point Representation, Other Binary Codes, Error Detection codes.

Computer Types, Generation of Computers.

Unit II :Register Transfer Language and Micro operations   **12 Hours**
Register Transfer Language And Micro operations: Register Transfer language, Register Transfer Bus and memory transfers, Arithmetic Micro operations, logic micro operations, shift micro operations, Arithmetic logic shift unit.
Basic Computer Organization And Design: Instruction codes, Computer Register Computer instructions, Timing and control, Instruction cycle, Memory – Reference Instructions, Input – Output and Interrupt.

Assembly Language, Design of basic computer.

Unit III: Central Processing Unit and Micro Programmed Control   **12 Hours**
Central Processing Unit: Stack organization, Instruction formats, Addressing modes, Data Transfer and manipulation, Program control, Reduced Instruction set computer.
Micro Programmed Control: Control memory, Address sequencing, Micro program example, Design of control unit.

General Register Organization, RISC Vs CISC Architecture.

Unit IV :Computer Arithmetic   **12 Hours**
Computer Arithmetic: Addition and subtraction with Signed Magnitude Data - Hardware Implementation – Multiplication – Hardware Implementation for Signed Magnitude Data – Division - Hardware Implementation for Signed Magnitude Data – Divide Overflow - Floating Point Arithmetic operations.

BCD Adder-BCD Subtraction

Unit V:The Memory System and Input-Output Organization   **12 Hours**
The Memory System: Main memory, Auxiliary memory, Associative Memory, Cache Memory, Virtual Memory.
Input-Output Organization : Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupts, Direct memory Access.

Synchronous data transfer, Memory Hierarchy

Text Books
1.   M. Morris Mano, "Computer System Architecture", Revised Third Edition, Pearson, 2017.

Reference Books
1.   Carl Hamacher, ZvonkoVranesic, Safwat Zaky, "Computer Organization", Fifth Edition, McGraw Hill.

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2. William Stallings, " Computer Organization and Architecture", Sixth Edition, Pearson.

Web Resources
1. https://nptel.ac.in/courses/106/105/106105163/
2. https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/
3. https://www.javatpoint.com/computer-organization-and-architecture-tutorial

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	40
L2	50	60
Total (%)	100	100

L1: Remember
1. What is instruction cycle?
2. Define Cache memory. Mention any two advantages.
3. List any five addressing modes.
4. What is asynchronous serial transfer?
5. What is an interrupt?
6. Write about auxiliary memory.
7. What is LIFO?
8. What is a mapping function?
9. List any three types of computers.
10. Define Hit ratio and Miss ratio.
11. What is circular shift micro operation?
12. What are peripherals?

L2: Understand
1. Compare RISC over CISC.
2. Explain the structure of a basic computer system.
3. Explain the concept of virtual memory. Why it is significant?
4. Explain the steps involved in the complete execution of an instruction.
5. Differentiate between hardwired control and micro programmed control.
6. Explain the functions of typical input-output interface.
7. Explain the functional architecture of the computer system.
8. Discuss about set-associative mapping.
9. Explain the method of DMA transfer.
10. Explain about the error detection codes.
11. Explain the design of basic computer

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PC **20CS306 Design and Analysis of Algorithms Lab**   0   0   3   **1.5**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO4
20CS306.1	Calculate the time and space complexities of simple algorithms	3
20CS306.2	Implement divide and conquer strategy for computing problems and analyse their performance complexity	3
20CS306.3	Implement greedy strategy for computing problems and analyse their performance complexity	3
20CS306.4	Implement dynamic programming strategy for computing problems and analyse their performance complexity	3
20CS306.5	Implement backtracking and branch & bound strategies for computing problems and analyse their performance complexity	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
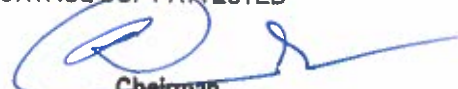L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

List of Experiments
1. Write simple non-recursive algorithms and compute their time complexities
2. Write recursive algorithms and compute their time complexities
3. Implement various sorting algorithms and compare their performance for varying inputs
4. Design and implement algorithms based on divide and conquer strategy to solve computing problems
   - i) Quick sort
   - ii) Merge sort
   - iii) Multiplication of large integers
5. Design and implement algorithms based on greedy strategy to solve following problems
   - i) Construction of minimal cost spanning tree
   - ii) Single source shortest path problem
   - iii) Job sequencing with deadlines
6. Design and implement algorithms based on dynamic programming principle to solve following problems
   - i) All pair shortest path algorithms
   - ii) 0/1 Knapsack problem
7. Design and implement algorithms based on backtracking principle to solve following problems
   - i) Hamiltonian circuit problem
   - ii) N-queen's problem
8. Design and implement algorithms based on branch and bound principle to solve following problems
   - i) Travelling Salesman problem
   - ii) Assignment problem

Reference
1. Lab Manual for Design and Analysis of Algorithms Lab Department of Computer Science and Engineering, NSRIT

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| PC | 20CS307 Database Management Systems Lab | 0 | 0 | 3 | 1.5 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		
		PO1	PO4	PSO1
20CS307.1	Implement database design concepts with ER diagrams	2	3	1
20CS307.2	Construct SQL queries for database manipulation	2	3	1
20CS307.3	Demonstrate PL/SQL programming	2	3	1
20CS307.4	Demonstrate Normalization techniques	2	3	1
20CS307.5	Execute various queries related to transaction processing and locking	2	3	1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create

List of Experiments

1. Design ER models for the given application
2. Construct SQL Queries to perform the following
   a. Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, viewing all databases, creating a database Viewing all Tables in a Database
3. Construct SQL Queries to perform the following:
   a. Altering a Table, Dropping /Truncating/Renaming Tables, backing up/Restoring a database
4. Write SQL program to perform different JOIN operations
5. Write PL/SQL program to create a Stored Procedure
6. Write PL/SQL program to create a Function.
7. Write PL/SQL program to create a Package
8. Write PL/SQL program for Trigger
9. Write SQL Queries to demonstrate Transaction Control Language
10. Design a complete Database for a chosen application

References

1. Lab Manual for "Database Management Systems Lab", Department of Computer Science and Engineering, NSRIT

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| **PC** | 20CS308 Object Oriented Programming through C++ Lab | 0 | 0 | 3 | 1.5 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	
		PO1	PO4
20CS308.1	Demonstrate the usage of I/O Functions	3	1
20CS308.2	Implement the concepts of class, objects	3	1
20CS308.3	Implement the concepts of Overloading	3	1
20CS308.4	Demonstrate the use of virtual functions & error handling mechanisms	3	1
20CS308.5	Implement generic programming and templates	3	1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create.

List of Experiments

1. Demonstrate input & output operations using streams in C++
2. Write Programs to illustrating Control statements.
3. Write Programs to demonstrate the usage of Arrays & Functions.
4. Write Demonstrate the usage of Classes & Objects
5. Write Programs illustrate Access Specifiers Public, Private, Protected
6. Write Programs to illustrate new and delete Keywords for dynamic memory allocation.
7. Write Programs to illustrate the usage of following: Default Constructor, Parameterized Constructor, Copy Constructor and Destructor.
8. Write Programs that illustrates the following:
   i. Friend Function ii. Inline function
9. Write Programs to illustrate Overloading Unary (++) & Assignment Operator (=).
10. Write Programs that illustrate the following forms of inheritance:
i. Single Inheritance   ii. Multiple Inheritances   iii. Hierarchical Inheritance
11. Write Programs to calculate the percentage of a student using multi-level inheritance. Accept the marks of three subjects in base class. A class will derived from the above mentioned class which includes a function to find the total marks obtained and another class derived from this class which calculates and displays the percentage of student.
12. Write Programs to illustrate this pointer
13. Write Programs to show an Example of Pointers to base class
14. Write Programs to illustrates pure virtual function and calculate the area of different shapes by using abstract class.
15. Write Programs to illustrate the usage of an exception Handling Mechanism.
16. Write Programs to demonstrate the usage of Templates.

References

1. Lab Manual for Object Oriented Programming through C++, Department of Computer Science and Engineering, NSRIT

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SC **20CSS01 Programming Basics**   0   0   4   2.0

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | DoK |
		PO3	PO4	PO5	
20CSS02.1	Demonstrate the basic programming principles to solve simple computing problems	3	2	2	L1, L2, L3
20CSS02.2	Write programs for moderately complex computing problems in different programming languages	3	2	2	L1, L2, L3
20CSS02.3	Solve computing problems in a time bounded environment	3	2	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Introduction to algorithms – Raptor tool – Fundamental programming principles – Algorithms for problems on arrays – Algorithms for problems on strings – Algorithms for text processing and pattern searching – Examples for non-recursive algorithms – Examples for recursive algorithms

References
1.   www.sanfoundary.com
2.   www.geeksforgeeks.com
3.   www.codechef.com
4.   www.topcoder.com
5.   www.codingninja.com
6.   www.hackerearth.com
7.   www.hackerrank.com

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20MCX02 Constitution of India

2 0 0 0.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO12	
20MCX02.1	Summerizing the basic features and modalities aboutIndian Constitution	3	3	1	L1
20MCX02.2	Identify the Indian Federalism and Panchayath Raj systems in Indian Constitution	3	3	1	L1
20MCX02.3	Identify theLegislature and Judiciary systems in Indian Constitution	3	3	1	L2
20MCX02.4	Interpreting the political system that exists in India	3	3	1	L1,L2
20MCX02.5	Categorising the contemporary issues in global politics and Election commission in India	3	3	1	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Indian Constitution
10 Hours

Meaning of the Indian Constitution, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Indian Constitution and its Salient Features, The role of B.R. Ambedkar in the making of the Indian Constitution,The Preamble of theConstitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional,The Historical Perspectives of the Constitutional Amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency and Local Self Government – Constitutional Scheme in India.

Unit II: Indian Federalism
10 Hours

Meaning and Definition of Federalism, Structure and Features of Indian Federalism, Difference between Indian and Federation of other States, Difference between Federal and Unitary Features, Critical Evaluation of the Indian Federal System, Decentralisation of Powers, Centre-State Relations, 73rdAmendment, Panchayath Raj Institutions.

Unit III: Union Government
10 Hours

Powers of Indian Parliament, Functions of RajyaSabha and LokSabha, Powers and Functions of the President, Powers and Functions of the Prime Minister. Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Lok Pal and LokAyukta, The Lokpal and Lokayuktas Act 2013.

Unit IV: Challenges to Indian Political System
10 Hours

Caste: A General Overview of the Indian Scenario,TheCaste Issues in the Pre Independence Period, Gandhi Ambedkar Debate and the Poona Pact.The Politics of Caste in the Post IndependencePeriod, Mandal Commission Reservation Policy in Government Jobs.The History of Communalism in India, The Concept of Terrorism and its Emergence in the Global Phenomenon since the End of Cold War.

Unit V: India's External Relations andElection Commission
10 Hours

Cold War and Post Cold War Era, Foreign Policy, Indian and its Neighbours, India's Extended Neighbourhood in West Asia and South East Asia. India's Relations with the United States and Russia, India and the World Organisations, India in the 21stCentury.Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission, Functions of Commissions for the welfare of SC/ST/OBC and women.

Text Books

1. Austin G., "Working of a Democratic Constitution of India", Oxford University Press, New Delhi,2004
2. Basu D.D.,"An Introduction to the Constitution of India", Prentice Hall, New Delhi,2005
3. Chandhoke N. and Priyadarshini, "Contemporary India: Economy, Society, Politics", Oxford University Press,New Delhi, 2009
4. Jayal N. G. and Maheta P. B., Oxford Companion to Indian Politics",Oxford University Press, New Delhi, 2010
5. VanaikA. and BharghavaR."Understanding Contemporary India: Critical Perspectives", Orient Blackswan, New Delhi, 2010

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Reference Books

1. Noorani A. G.,"Constitution Questions in India: The President, Parliament and the States", Oxford University Press, New Delhi, 2000
2. Chakravarthy B.and Pandey K. P., "Indian Government and Politics", Sage Publications, New Delhi, 2006
3. Bajpai. Kanti and Pant V. Harsh,"India's Foreign Policy: A Reader", Oxford University Press, New Delhi, 2013
4. Laxmikanth M., "Indian Polity for Civil Services Examinations", Tata McGraw Hill, New Delhi, 2016
5. Singh M.P. andSaxena R.,"Indian Politics: Contemporary Issues and Concerns", PHI Learning,New Delhi, 2008

Web References

1. https://en.wikipedia.org/wiki/Federalism.in.India
2. https://legislative.gov.in/constitution-of-india
3. https://en.wikipedia.org/wiki/Foreign_relations_of_India
4. https://en.wikipedia.org/wiki/Government_of_India

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HS   20HSX03 Managerial Economics and Financial Analysis   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO11	PO12	
20HSX03.1	Understand the theoretical concepts of managerial economics to make decisions for business problems	3	1	L1, L2
20HSX03.2	Gain adequate theoretical knowledge on microeconomics concepts to perform successful business operations	3	1	L1, L2
20HSX03.3	Understand the basic accounting principles and capital formation and planning	3	1	L1, L2
20HSX03.4	Apply accounting concepts to analyze financial strength of business	3	1	L3, L4
20HSX03.5	Gain theoretical knowledge on the entrepreneurship management and types of firms	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UnitI: Introduction to Managerial Economics and Demand Analysis   9 Hours
Definition of Managerial Economics –Scope of Managerial Economics and its Relationship with other Subjects – Concept of Demand, Types of Demand, Determinants of Demand- Demand Schedule, Demand Curve, Law of Demand and its Limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand Forecasting and Methods of Forecasting.

Role of Managerial Economist, Law of Supply

Unit II: Production and Cost Analysis   9 Hours
Theory of Production: Meaning and Factors of Production, Production Function with One Variable Input (Law of Variable Proportion), With Two Variable Inputs (Law of Returns to Scale) Theory of Cost: Different Cost Concepts and Different Relations between Cost and Output in Short Run and Long Run. Managerial uses of Revenue and Cost Concepts Break-Even Point). Pricing Strategies.

Economies of Scale and Diseconomies of Scale

Unit III: Introduction to Accounting andFinancial Planning   9 Hours
Financial Accounting- Concepts and Conventions – Double Entry System – Preparation of Journal, Ledger and Trial Balance – Preparation of Final Accounts: Trading, Profit and Loss Account and Balance Sheet.
Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time Value of Money- Methods of Appraising Project Profitability -Traditional Methods and Modern Methods.

Branches of Accounting, Concept of Working Capital

Unit IV: Financial Analysis through ratios   9 Hours
Computation, Analysis and Interpretation of Liquidity Ratios (CurrentRatio and Quick Ratio), Activity Ratios (Inventory Turnover Ratio and Debtor Turnover Ratio), Capital StructureRatios (Debt- Equity Ratio, Interest Coverage Ratio) and Profitability Ratios (Gross Profit Ratio, Net ProfitRatio,Operating Ratio, P/E Ratio and EPS).

Cash Flow Statement and Funds Flow Statement (Theory Only)

Unit V: Introduction of Entreprenuershipand New Economic Environment   9 Hours
Definition of Entrepreneur and Entreprenuership, Internal and External Factors; Types of Entrepreneurs; Classification of Entrepreneurship.
Characteristic Features of Business, Features and Evaluation of SoleProprietorship, Partnership, Joint Stock Company, Public Enterprises, Changing Business Environment in Post-Liberalizations Scenario.

Industrial Policy 1991

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Text Books

1. AppaRao N., Vijay Kumar P., "Managerial Economics and Financial Analysis", Cengage Publications, New Delhi, 2011
2. Siddiqui S. A. and Siddiqui A. S., "Managerial Economics and Financial Analysis", New Age International Publishers, 2012
3. Kuberudu B. and Ramana T. V., "Managerial Economics and Financial Analysis", Himalaya Publishing House, 2014
4. Aryasri A. R., "Managerial Economics and Financial Analysis", Tata Mcgraw Hill, 2011

Reference Books

1. Maheswari V., "Managerial Economics", Sultan Chand, 2014
2. Suma Damodaran, " Managerial Economics", Oxford, 2011
3. Vanitha Agarwal, " Managerial Economics", Pearson Publications, 2011
4. Sanjay Dhameja, "Financial Accounting for Managers", Pearson Publications, 2011
5. Maheswari V., "Financial Accounting", Vikas Publications, 2012
6. Dominick Salvatore, "Managerial Economics: Principles and World Wide Application", 7th Edition, Oxford University Press, 2012

Web References

1. https://btechgeeks.com/mefa-notes/#google_vignette
2. https://www.smartzworld.com/notes/managerial-economics-and-financial-analysis-pdf-notes-mefa
3. https://www.scribd.com/document/259129127/Mefa-course-plan
4. https://www.coursera.org/browse/business/entrepreneurship

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	20	20
L3	20	20
L4	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Managerial Economics?
2. What is meant by Elasticity of demand? How do you measure it?
3. Define different product curves
4. Define Accounting
5. Define Partnership

L2: Understand

1. Explain the role of a Managerial Economist in a Business firm
2. Explain the concept cross elasticity of demand. Illustrate your answer with suitable examples
3. Explain the formation of a Joint Stock Company
4. Distinguish between a partnership and a joint stock company
5. Explain accounting principles

L3: Apply

1. Journalise the following transactions
   2013 Jan 1st   ABC Firm commenced business with Rs.40000
   Jan 2nd   Deposited into bank Rs.30000
   Jan 3rd   Bought goods worth Rs.48000 from Kamala
   Jan 4th   Sold goods worth Rs.60000
2. Calculate Net Profit Ration from the following data
   Sales returns Rs.100000   Administration expences Rs.10000

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Gross Profit Rs.40000   Selling expences Rs.10000
Income from investment Rs.5000 Loss on account of fire Rs.3000

3. From the following particulars findout

   Selling price   Rs.200 per unit
   Variable cost   Rs.100 per unit
   Total fixed cost Rs.96000
   i) Break even units and values
   ii) Sales to eam a profit Rs.20000

4. The following are the Ratios related to XYZ Limited company.
Inventory holding period 2 months
Gross profit ration   25 %
Gross profit for the current year announced Rs.200000
Closing stock is excess of Rs 40000 over opening stock. Findout
A) Sales
B) Cost of goods sold
C) Closing stock
D) Opening stock

L4: Analyze

1. A Project cost is Rs.144000. The average annual cash inflows are likely to be Rs.45000 for a period of 5 Years calucalte IRR for the project
2. The cost of project is Rs.50000 The annual cash iunflows for the next 4 years are Rs.25000 what is the PBP for the project
3. A firm is considering two different investment options A & B detailes of both the options are given below (Rs,in Lakhs)

	Investment cost	Inflow 1	Inflow 2	Inflow 3
Option A	(25)	10	10	12
Option B	(40)	15	20	24

4. ARR method (ARR on original investment)
Inintial investment Rs.1200000

Year	Cashinflows (Rs)	
	Project A	Project B
1	600000	500000
2	500000	300000
3	200000	200000
4	-	300000

PC **20CS402 Data Warehousing and Mining**   3   1   0   3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO2	
20CS402.1	Understand and design Data Warehouse System and acquiring knowledge on OLAP Tools	3	1	L1, L2
20CS402.2	Apply suitable pre-processing and visualization techniques for Data Analysis	3	1	L1, L2
20CS402.3	Understand and Apply Frequent pattern and Association Rule mining Techniques for Data Analysis	3	1	L1, L2, L3
20CS402.4	Understand and Apply Classification Techniques for Data Analysis	3	1	L1, L2, L3
20CS402.5	Apply appropriate clustering techniques for data analysis	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Data Warehousing   **9 + 3 hours**
Data Warehousing, Business Analysis and On-Line Analytical Processing (OLAP): Basic Concepts, Data Warehousing Components, Building a Data Warehouse, Database Architectures for Parallel Processing, Parallel DBMS Vendors, Multidimensional Data Model, Data Warehouse Schemas for Decision Support, Concept Hierarchies, Characteristics of OLAP Systems, Typical OLAP Operations, OLAP and OLTP.

Characteristics of OLAP Systems

Unit II: Data Mining   **12 + 3 hours**
Introduction: Introduction to Data Mining Systems, Knowledge Discovery Process, Data Mining Techniques, Issues, applications, Data Objects and attribute types, Statistical description of data, Data Preprocessing Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and Dissimilarity measures.

Reduction, Data Visualization

Unit III: Classification   **12 + 3 hours**
Introduction and Basic Concepts of Classification. Decision Tree Induction, Working of Decision Tree, Building a Decision Tree, Measures for selecting best split. Bayes' Theorem, Rule Based Classification, Classification by Back propagation, Techniques to improve Classification.

Techniques to improve Classification

Unit IV: Association Analysis   **6 + 2 hours**
Introduction to Association and Correlation. Frequent set generation and Association Rule generation using Apriori Algorithm, FP-Growth Algorithm, Pattern Mining in Multilevel, Multi- Dimensional Space

Multi-Dimensional Space

Unit V: Clustering and Outlier Analysis   **8 + 2 hours**
Cluster Analysis, Partition Methods, Hierarchical Methods, DBSCAN, Clustering with Constraints, Outlier Analysis, Outlier Detection Methods.

Outer Detection methods

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Text Books

1. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques",Third Edition, Elsevier, 2012.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining",Pearson,2016

Reference Books

1. Alex Berson and Stephen J.Smith, — "Data Warehousing, Data Mining & OLAPII", Tata McGraw – Hill Edition, 35th Reprint 2016.
2. K.P. Soman, ShyamDiwakar and V. Ajay, — "Insight into Data Mining Theory and PracticeII", Eastem Economy Edition, Prentice Hall of India, 2006.
3. Ian H.Witten and Eibe Frank, — "Data Mining: Practical Machine Learning Tools and Techniques", Elsevier, Second Edition

Web Resources

1. https://www.saedsayad.com/data_mining_map.htm
2. https://nptel.ac.in/courses/106/105/106105174/
3. http://onlinecourses.nptel.ac.in/noc17_mg24/preview
4. http://www.saedsayad.com/data_mining_map.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

L1: Remembering

1. What is Data Warehouse
2. What is Data Mining
3. What is Data processing
4. Write any 3 functions of Data Mining
5. List any 3 measures for selecting the attributes for a decision tree
6. Write any 3 types of clusters
7. What is DB scan

L2: Understanding

1. Explain star schema
2. Explain support and confidence
3. Explain concept hierarchies
4. Write any 4 differences of training data and test data
5. Write any 3 differences between superwised learning and unsuperwised learning

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| PC | 20CS403 Python Programming | 3 | 1 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20CS403.1	Illustrate the use of basic concepts of Python Programming	3	1	L1, L2
20CS403.2	Demonstrate the use of control Structures and Data Structures in Python	3	1	L1, L2
20CS403.3	Build programs using functions for resolving simple problems	3	1	L1, L2
20CS403.4	Explain the usage of Object oriented concepts and files	3	1	L1, L2
20CS403.5	Apply mathematical libraries for analyzing data sets with GUI	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction   9 + 3 Hours
Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Keywords, Reading Input from the Keyboard, Performing Calculations

Operators: Arithmetic Operators, Comparison (Relational) Operators, Bitwise Operators, Logical Operators, Assignment Operators, Membership Operators, Identity Operators, Type Conversions, Expressions, More about Data Output.

More about Data Output

Unit II: Control Statements, Data Structures and Strings   9 + 3 Hours
Control Statements: If, if-Else, For, While, Break, Continue, Pass
Data Structures: List, Tuples, Sets, Dictionaries, Sequences, List Comprehension
Strings: String Formatting, Accessing Character and Substring in Strings, Data Encryption, Strings and Number Systems, String Methods

More about While, Continue

Unit III: Functions and Modules   9 + 3 Hours
Functions: Defining Simple Functions, Functions as Abstraction Mechanisms, Problem Solving with Top - Down Design, Design with Recursive Functions, Case Study Gathering Information from a File System, Managing a Program's Namespace, Higher Order Function.
Modules: Creating Modules, Import Statement, From. Import Statement, Name Spacing, Builtin Modules - Os, Random, Math, Cmath, Pprint, Json, Request, Date, Regex.
Packages: Introduction to PIP, Installing Packages using PIP.

More Programs using Functions

Unit IV: File Operations and OOPs   9 + 3 Hours
File Operations: Reading Config Files In Python, Writing Log Files In Python, Understanding Read Functions, Read(), Readline() and Readlines(), Understanding Write Functions, Write() and Writelines(), Manipulating File Pointer using Seek, Programming using File Operations.
Object Oriented Programming: Concept of Class, Object and Instances, Constructor, Class Attributes and Destructors, Real Time use of Class in Live Projects, Inheritance, Overlapping and Overloading Operators, Adding and Retrieving Dynamic Attributes of Classes, Programming using OOPs Support.
Design with Classes: Objects and Classes, Data Modeling Examples, Case Study on ATM, Structuring Classes with Inheritance and Polymorphism.

Case Study on Library

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UnitV: Graphical User Interfaces: **9+3 Hours**

Graphical User Interfaces: The Behavior of Terminal Based Programs and GUI -Based, Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources.

Programming: Introduction to Programming Concepts with Scratch.

Mathematical Libraries: NumPy, SciPy, Sympy, Pandas, StatsModels, Matplotlib and Gnuplot.

Other Useful GUI Resources

Text Books

1. Kenneth A. Lambert, " Fundamentals of Python First Programs", 1st Edition, Cengage, 2017
2. Vamsi Kurama, "Python Programming: A Modern Approach", 1st Edition, Pearson, 2018
3. Mark Lutz, "Learning Python", 1st Edition, Orielly, 2019

Reference Books

1. Gowrishankar S., Veena A., "Introduction to Python Programming", CRC Press, 2019
2. Daniel Liang Y., "Introduction to Programming Using Python", 1st Edition, Pearson, 2012
3. Allen Downey, "Think Python", 2nd Edition, Green Tea Press, 2017
4. Chun W., "Core Python Programming", 2nd Edition, Pearson, 2006

Web References

1. https://www.tutorialspoint.com/python3/python_tutorial.pdf

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

L1: Remember

1. What is the difference between list and tuples in Python?
2. What are the key features of Python?
3. What type of language is python?
4. How is Python an interpreted language?
5. What is pep 8?

L2: Understand

1. Give a comparison between lists, tuples, dictionaries and sets
2. Explain about methods in Lists of Python with appropriate examples
3. Explain the operators in python with appropriate examples
4. Explain how to implement inheritance in Python
5. Explain modules and Packages

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| PC | 20CS404 Operating Systems | 3 | 1 | 0 | 3 |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
		PO1	PO12	
20CS404.1	Describe the structure, components and functionalities of operating system	3	1	L1, L2
20CS404.2	Describe the process management activities of operating system	3	1	L1, L2
20CS404.3	Illustrate the use of process synchronization tools	3	1	L1, L2
20CS404.4	Describe the various memory management and allocation techniques	3	1	L1, L2
20CS404.5	Demonstrate different secondary storage management strategies and file system	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Operating System Concepts   9 + 3 Hours
What operating system do, operating system operations, Process management, Memory management, Storage management, Protection and security, Computing environments, operating systems services, System call, Types of system call, Operating system generation, System boot

The Shell, Mobile Operating System, Choice of Interface

Unit II: Process Management   9 + 3 Hours
Process concept:The process, Process state, Process control block, Threads, Process scheduling: Scheduling queues, Schedulers, Context switch, Operations on processes, Inter process communication.
Multithread programming: Overview, Benefits, Multithreading models.
Process scheduling:Basic concepts, Scheduling criteria, Scheduling algorithms.

Process Termination, Multiprocess Architecture

Unit III: Synchronization   9 + 3 Hours
Background, The Critical-section problem, Peterson's solution, Synchronization hardware, Semaphores, Classic problems of synchronization, Monitors.
Deadlocks:System model, Deadlock characterization, Methods for handling deadlock, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

Transactional Memory, Two Phase Locking

Unit IV: Memory Management   9 + 3 Hours
Background, Swapping, Contiguous memory allocation, Segmentation, Paging, Structure of the page table.
Virtual memory management: Background, Demand paging, Page replacement, Thrashing.
Mass-Storage Structure: Overview of Mass-Storage Structure, Hard disk drives, Volatile memory, HDD Scheduling-FCFS Scheduling, SCAN Scheduling, Selection of a Disk-Scheduling Algorithm.

Buddy System, Prepaging

Unit V: File system Interface   9 + 3 Hours
File concept, Access methods, Directory and disk structure, File system mounting, File sharing, Protection.
Implementing file systems: File system structure, File system implementation, Directory implementation, allocation methods, free-space management.

Consistency Checking, Malware, Denial of service

Text Books
1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne,"Operating System Concepts", TenthEdition,John Wiley and Sons Inc., 2018
2. William Stallings,"Operating Systems - Internals and Design Principles", Ninth Edition, Pearson, 2018

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Reference Books

1. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson, 2015
2. Charles Crowley, "Operating Systems: A Design-Oriented Approach", First Edition, Tata McGrawHill Education, 2001
3. Dhananjay M. Dhamdhere, "Operating Systems: A Concept-Based Approach", Third Edition, McGrawHill Higher Education, 2017

Web Resources

1. http://nptel.ac.in/downloads/106108101/
2. https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems
3. https://www.geeksforgeeks.org/operating-system-introduction-operating-system-set-1/
4. https://www.unf.edu/public/cop4610/ree/Notes/PPT/PPT8E/CH12-OS8e.pdf
5. https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	40
L2	50	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Operating System
2. What are operating system services?
3. List any four types of system calls
4. What is a process? List any four fields of process control block
5. What are the necessary conditions for a deadlock?
6. Differentiate between binary and counting semaphore.
7. What are the various attributes that are associated with an opened file?

L2: Understand

1. Discuss the essential properties of operating systems -Batch, Interactive, Timesharing Real time and Distributive
2. Explain how multiprogramming increases the utilization of CPU
3. Why system calls are needed in operating system?
4. Distinguish between logical address and physical address
5. What is the difference between a process and thread?
6. How does the system detect thrashing? What can the system do to eliminate this problem?
7. Consider the following four processes represented as (Process, Arrival Time, Burst Time) with the length of CPU burst in milliseconds.
   { (P1, 0, 10), (P2, 1, 7), (P3, 2, 13), (P4, 3, 11) }. Using preemptive SJFscheduling: (i) Draw Gantt chart
   (ii) Calculate average waiting time.
8. Why semaphores are important? Suggest the solution for bounded bufferproblem with semaphores
9. Explain the steps involved in handling a page fault with aneat sketch

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| PC | 20CS405 Theory of Computation | | 3 | 1 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO2	
20CS405.1	Construct Automata, Regular Expression for any pattern	3	1	L1, L2
20CS405.2	Write Context free grammar for any Construct.	3	1	L1, L2
20CS405.3	Design Turing machine for any Language	3	1	L1, L2
20CS405.4	Describe the different phases of a compiler	3	1	L1, L2, L3
20CS405.5	Apply different parsing algorithm to develop the parser for a given grammar	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I:Introduction to Finite Automata and Regular Expression
9 + 3 Hours

Why study of Automata theory, Concepts of Automata, Acceptance of String, Definitions of alphabet, strings, language, grammar, types of grammar, Deterministic finite automata, non-Deterministic Finite Automata, Design of NFA, equivalence of NFA and DFA Conversion of NFA to DFA, Finite Automata with epsilon transitions, Minimization of Finite automata, Mealy and Moore machines, Applications and limitations, Regular expressions, regular sets, Identity rules, Equivalence of two regular expressions, Finite automata and regular expressions, Inter conversion, closure properties, Regular Expressions and Regular grammars, Applications of regular Expressions.

Comparison between Mealy and Moore, Conversion of NFA with ε moves to DFA

Unit II: Context free Grammar &Push Down Automata
9 + 3 Hours

Classification of Grammars, Left Most and Right Most Derivations, Ambiguous Grammar, Elimination of Useless, Epsilon, Unit Symbols, Normal Forms, Pumping Lemma, Applications, Pushdown Automata, Definition, Graphical Notation, Design of Push Down Automata, Equivalence of Push Down Automata and Context free grammar, Applications of Push Down Automata

Applications of Push Down Automata, Classification of types of grammars

Unit III: Turing Machines and Computability
9 + 3 Hours

Turing Machines Definition, Turing Machine Model, Representation of Turing machine, Instantaneous description, Transition diagram, ways of representing Turing machine's- tabular form, diagram, church's thesis, universal Turing machine, Decidable and Un decidable problems, Halting Problems, Classes of P and NP Problems.

Applications of Turing Machine

Unit IV: Introduction to compilers and Syntax Analysis
9 + 3 Hours

Introduction to Language processing, Structure of a compiler, Lexical Analysis role, specification of tokens, Syntax Analysis role, Context free grammars writing a grammar, Top down, bottom up parsing and LR parsing, LR1,LALR parsers, Syntax Directed Transactions

Comparison between different types of parsers, CLR parser

Unit V:Intermediate Code and Code Optimization
9 + 3 Hours

Generation variants of Syntax tree 3 Address code, Types and Declaration Type Checking, Back patching, Machine independent optimization, A simple code generation, basic blocks and flow graphs, The principle sources of Optimization peep hole, Introduction to Data flow Analysis.
Code Optimization: Principal sources of Code Optimization, Loop Optimization, Basic Blocks & Flow Graphs, DAG Representation of Basic Blocks, Applications of DAG, and Local Optimization. Performing three address code, Construction of directed acyclic graph

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Text Books

1. John.E.H.PCroft / Rajeev Motwani&JD Ullman ,"IntroductiontoAutomata Theory,LanguagesandComputation",Pearson Education- IIIEdition
2. Alfred V Aho,JeffreyD.Ullman, Monica LamandRaviSethi "PrinciplesofCompiler Design", Pearson Education, Second Edition

Reference Books

1. K.L.P.MishraandN.Chandrasekhar "Theoryofcomputation",PHI
2. Kenneth.C.Louden,"CompilerConstruction",Vikas Publication House, 2015
3. DhananjayStevenMuchnic, "Advanced Compiler Design and Implementation",ElsevierPublications

Web Resources

1. http://nptel.ac.in/courses/106/106/106106049/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

L1: Remember

1. Define DFA and NFA
2. Write the Identity rules
3. Write Normal Forms.
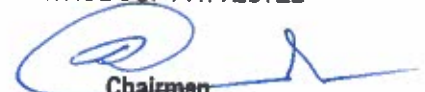4. Write any five Applications of Pumping lemma
5. What is Lexical Analysis

L2: Understand

1. Explain Chomsky hierarchy
2. Construct Parse tree for a given grammar S->AB/a A->b,B->a
3. Explain all phases of Compiler
4. Check whether the Given grammar is Ambiguous or not
5. Explain three address code

L3: Apply

1. Apply Different Parsing Algorithms
2. Construct Turing Machine for a given grammar
3. Construct DFA and NFA with suitable example
4. Minimize the Given Finite Automata for the sting accepting even a's and even b's
5. Construct SLR parsing table for the grammar S->AB/a A->b,B->a
6. Convert NFA to DFA for the string accepting 0101

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`PC` **20CS406 Data Mining Lab**   0   0   3   1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO4
20CS406.1	Extend the functionality of R by using add-on packages	3
20CS406.2	Examine data from files and other sources and perform various data manipulation tasks on them	3
20CS406.3	Code statistical functions in R	3
20CS406.4	Use R Graphics and Tables to visualize results of various statistical operations on data	3
20CS406.5	Apply the knowledge of R gained to data Analytics for real life applications	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

List of Experiments

1. Implement all basic R commands
2. Interact data through .csv files (Import from and export to .csv files)
3. Get and Clean data using swirl exercises. (Use 'swirl' package, library and install that topic from swirl)
4. Visualize all Statistical measures (Mean, Mode, Median, Range, Inter Quartile Range etc., using Histograms, Box plots and Scatter Plots)
5. Create a data frame with the following structure.

EMP ID	EMP NAME	SALARY	START DATE
1	Satish	5000	01-11-2013
2	Vani	7500	05-06-2011
3	Ramesh	10000	21-09-1999
4	Praveen	9500	13-09-2005
5	Pallavi	4500	23-10-2000

   i. Extract two column names using column name.

   ii. Extract the first two rows and then all columns.

   iii. Extract 3rd and 5th row with 2nd and 4th column

6. Write R Program using 'apply' group of functions to create and apply normalization function on each of the numeric variables/columns of iris dataset to transform them into
      i.   0 to 1 range with min-max normalization.
      ii.   a value around 0 with z-score normalization.
7. Create a data frame with 10 observations and 3 variables and add new rows and columns to it using 'rbind' and 'cbind' function.
8. Write R program to implement linear and multiple regression on 'mtcars' dataset to estimate the value of 'mpg' variable, with best R^2 and plot the original values in 'green' and predicted values in 'red'.
9. Implement k-means clustering using R.
10. Implement k-medoids clustering using R.
11. Implement density based clustering on iris dataset.
12. Implement decision trees using 'reading Skills' dataset.
13. Implement decision trees using 'iris' dataset using package party and 'rpart'.
14. Use a Corpus() function to create a data corpus then Build a term Matrix and Reveal word frequencies.

Reference

1. Lab Manual for Data Warehousing and Data Mining Lab Department of Computer Science and Engineering, NSRIT

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| PC | 20CS407 Python Programming Lab | 0 | 0 | 3 | 1.5 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs
		PO4
20CS407.1	Make use of Control Structures in Python Programming	3
20CS407.2	Create Programs using Functions	3
20CS407.3	Build the Programs using OOPs principles	3
20CS407.4	Make use of functions to draw turtle graphics	3
20CS407.5	Develop the programs using MatPlotlib library	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. a. Write a program that asks the user for a weight in kilograms and converts it to pounds
    b. Write a program to find total and average of 3 numbers
    c. Write a program that uses a for loop to print the numbers 8, 11, 14, 17, 20, . . . , 83, 86, 89
2. a. Write a program that should print out the user's name the specified number of times
    b. Use for loop to print a triangle like the one below. Allow the user to specify how high the triangle should be

    ```
    *
    **
    ***
    ****
    ```

    c. Generate a random number between 1 and 10. Ask the user to guess the number and print a message based on whether they get it right or not
3. a. Write a program that asks the user for two numbers and prints Close if the numbers are within .001 of each other and Not close otherwise
    b. Write a program that asks the user to enter a word and prints out whether that word contains any vowels
    c. Write a program that asks the user to enter two strings of the same length. If they are not, the program should print an appropriate message and exit
4. a. Write a program that asks the user for a large integer and inserts commas into it according to the standard American convention for commas in large numbers
    b. Write a program that asks the user for an algebraic expression and then inserts multiplication symbols where appropriate
5. Write a program that generates a list of 20 random numbers between 1 and 100.
    Print the list.
    a. Print the average of the elements in the list.
    b. Print the largest and smallest values in the list.
    c. Print the second largest and second smallest entries in the list
    d. Print how many even numbers are in the list
6. a. Write a program that asks the user for an integer and creates a list that consists of the factors of that integer
    b. Write a program that generates 100 random integers that are either 0 or 1. Then find the longest run of zeros, the largest number of zeros in a row
    c. Write a program that removes any repeated items from a list so that each item appears at most once. For instance, the list [1,1,2,3,4,3,0,0] would become [1,2,3,4,0]
7. a. Write a function called sum digits that is given an integer num and returns the sum of the digits of numbers
    b. Write a function called first_diff that is given two strings and returns the first location in which the strings differ. If the strings are identical, it should return -1
    c. Write a function called number_of_factors that takes an integer and returns how many factors the number has
    d. Write a function called is_sorted that is given a list and returns True if the list is sorted and False otherwise
8. a. Write a function called root that is given a number x and an integer n and returns x1/n. In the function definition, set the default value of n to 2
    b. Write a function called primes that is given a number n and returns a list of the first n primes. Let the default value of n be 100
    c. Write a function called merge that takes two already sorted lists of possibly different lengths, and merges

them into a single sorted list:
    i.   Do this using the sort method
    ii.   Do this without using the sort method

9.   a. Write a program that reads a file consisting of email addresses, each on its own line. Your program should print out a string consisting of those email addresses separated by semicolons.
      b. Write a program that reads a list of temperatures from a file called temps.txt, converts those temperatures to Fahrenheit, and writes the results to a file called ftemps.txt.

10.   Write programs to demonstrate the usage of class
11.   Write programs to demonstrate the usage of GUI
12.   Write programs to demonstrate the usage MatPlotlib library

References

1.   Lab Manual for "Python Programming", Department of Computer Science Engineering, NSRIT

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| PC | 20CS408 Operating Systems Lab | 0 | 0 | 3 | 1.5 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	
		PO1	PO4
20CS408.1	Demonstrate the basic UNIX commands and system calls	3	1
20CS408.2	Implement various CPU scheduling algorithms	3	1
20CS408.3	Implement different algorithms for process communication and synchronization	3	1
20CS408.4	Implement algorithms to handle deadlock situations	3	1
20CS408.5	Implement different memory management techniques and page replacement algorithms	3	1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create..
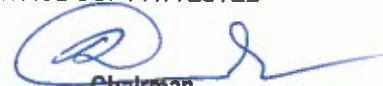
List of Experiments

1. Study of various Unix/Linux general purpose utility command list: man, who, cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown
2. Implementation of fork ( ), wait ( ), exec ( ), and exit ( ), System calls
3. Implementation of cp command with the use of open ( ), read ( ), write ( ) system calls
4. Implement the following CPU scheduling algorithms
   (a) FCFS   (b) SJF   (c) Priority   (d) Round Robin
5. Implement two process communication using shared memory
6. Implement two process communication using Pipes
7. Implement Dinning Philosopher's problem using semaphores
8. Implement Producer Consumer problem using semaphores
9. Implement Bankers algorithm for Deadlock Prevention
10. Implement Bankers algorithm for Deadlock Avoidance
11. Implement the memory management techniques of Multiprogramming with fixed number of tasks (MFT)
12. Implement the memory management techniques of Multiprogramming with variable number of tasks (MVT)
13. Implement the following page replacement algorithms
    (a) FIFO   (b) LRU   (c) LFU

References

1. Lab Manual for Operating Systems Lab, Department of Computer Science and Engineering, NSRIT

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| SC | 20CSS02 Competitive Programming Essentials | 0 0 4 4.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO3	PO4	PO5	
20CSS02.1	Diagnose the time and space complexity of program structure	3	2	2	L1, L2
20CSS02.2	Analyse the problem statement, select appropriate design strategy, implement it in a time bounded environment	3	2	2	L1, L2, L3, L4
20CSS02.3	Take part in competitive programming contests	3	2	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Introduction to competitive programming platforms – GCC complier – Description of problem statements in competitive programming – Constraints of the problems – Handling large inputs – Examples for Dynamic Programming - Examples for Greedy algorithms – Examples on string algorithms – Calculating the performance of algorithms – Reducing the time complexity of algorithms – Programming standards – Exposure to time bounded programming –Tips and Tricks for competitive programming and related resources

Resources
1. www.sanfoundary.com
2. www.geeksforgeeks.com
3. www.codechef.com
4. www.topcoder.com
5. www.codingninja.com
6. www.hackerearth.com
7. www.hackerrank.com

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PC **20CS501 Java Programming**   **3   1   0   3.0**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	**PO12**	
20CS501.1	Explain the features of java Programming	3	1	L2
20CS501.2	Ilustrate the concept of Class, Object and Constructors	3	1	L1, L2
20CS501.3	Demonstrate the use of interfaces, Packages, Multithreading and exception handling	3	1	L1, L2, L3
20CS501.4	Demonstrate the use of Applets and Event handling	3	1	L1, L2, L3
20CS501.5	Demonstrate generic programming and templates	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Object Oriented Programming   9+3 Hours
Introduction to OOP: Introduction to Object Oriented Programming, History of JAVA, Java Virtual Machine, Java Features, Program structures, Primitive Data types, Variables, Operators, Type Conversion, Arrays- Declaration and Initialization of Arrays, Operations on Array Elements, Arrays as Vectors

Flow of control-Branching and Looping statements

Unit II: Classes ,Objects, Constructors, Inheritance   9+3 Hours
Classes and Objects: classes, Objects, Creating Objects, Methods, constructors, Nested Classes, static keyword, Command line arguments, Garbage collector, Inheritance: Types of Inheritance, super keyword, final keyword , Method overloading, Method Overriding, Abstract class.

Constructor Overloading, this Keyword.

Unit III: Interfaces, Packages, Exception Handling, Multithreading   9+3 Hours
Interfaces, Interface Vs Abstract classes, Packages-Creating packages, Using Packages, Access protection, Exceptions-Introduction, Exception handling techniques-try...catch, throw, throws, finally block, user defined exceptions, Assertions
Multithreading: introduction, Thread, the main Thread, thread life cycle, Creation of threads, Thread priority, thread synchronization, Inter thread communication.

Multi Catch, Thread priority.

Unit IV: Strings, Applets,   9+3 Hours
Input/Output: reading and writing data, File handling using streams.
String Handling in Java: String classes and methods, string buffer
Applets- Applet class, Applet structure, Applet Life Cycle, paint(),update() and repaint(),Sample Programs

String builder class

Unit V: Event Handling, Java AWT   9+3 Hours
Event Handling -Introduction, Event Delegation Model, Sources of Events, Event Listeners, Adapter classes, Inner classes
AWT: Why AWT? Components and Containers, Button, Label, Checkbox, List boxes, Choice boxes, Text field and Text area, Menu, Scroll bar, Layouts-BorderLayout, GridLayout,.

Radio buttons, GridBagLayout

Text Books
1. Herbert Schildt., "The complete Reference Java", 8th Edition, TMH, 2011.
2. Sachin Malhotra., SaurabhChoudary, "Programming in JAVA", Oxford,2014
3. Daniel Liang Y., "Introduction to java programming", 7th Edition, Pearson, 2009.

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Reference Books
1. P. Radha Krishna., "Object Oriented Programming through Java", Universities Press, 2016.
2. K.Rajkumar., "JAVA Programming",1st Edition, Pearson, 2013.

Web References
1. https://www.javatpoint.com/java-tutorial
2. https://www.geeksforgeeks.org/java
3. https://beginnersbook.com
4. https://www.tutorialspoint.com/java

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
1. Write any four Applications of OOP
2. Define Class & object
3. What is constructor overloading?
4. What is use of Threads?
5. What is Exception handling?
6. What is a Container?

L2: Understand
1. Explain any four object oriented principles
2. Explain three types of constructors with example
3. Explain types of inheritance
4. Illustrate the use of super keyword with example
5. Explain the exception handling mechanism.
6. Explain Applet Life cycle with example
7. Explain Event handling with example
8. Write any four differences between application Programs and applets
9. Explain the following AWT components with example
   i) Button ii) Check boxes iii) Radio buttons

L3: Apply
1. Implement employee class to get and print details.
2. Apply the concept of inheritance to read and print student information
3. Solve to find the area of different shapes using abstract class

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| **PC** | **20CS502 Computer Networks** | | | | **3** | **0** | **0** | **3.0** |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO12	
20CS502.1	Describe the functions of each layer in OSI model	3	1	1	L1, L2
20CS502.2	Describe the functions of data link layer and the protocols	3	1	1	L1, L2
20CS502.3	Explain the functions of network layer and its protocols	3	1	1	L1, L2
20CS502.4	Illustrate the session layer issues and transport layer services	3	1	1	L1, L2
20CS502.5	Exemplify the functions of application layer and presentation layer and their protocols	3	1	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introductionto Networks   **12 Hours**
Network Topologies, Network Hardware, Network Software. Reference models- The OSI Reference Model- the TCP/IP Reference Model - Physical Layer: Guided Transmission Media, Digital Modulation & Multiplexing, Public Switched Telephone Network

Network Devices; The Mobile Telephone System

Unit II:Data Link Layer   **12 Hours**
Data Link Layer Design issues, Error Detection &Correction, Elementary Data Link protocols, Sliding window protocols
The Medium Access control sublayer: Multiple access protocols, Wireless LANS

Bluetooth, Data Link layer switching

Unit III: Network Layer   **12 Hours**
Design Issues-The Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality of Service, The Network Layer in the Internet.

Routing for mobile hosts, Routing in Ad Hoc Networks.

Unit IV: Transport Layer   **12 Hours**
The Transport Service, Elements of Transport Protocols, The Internet Transport Protocols: UDP, The Internet Transport Protocols: TCP, Performance issues.

Delay-Tolerant Networking: DTN Architecture, The Bundle protocols

Unit V: Application Layer   **12 Hours**
The Domain Name System: The DNS Name Space, Resource Records, Name Servers, Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery

World Wide Web; Streaming Audio &Video

Text Books
1. Tanenbaum and David J Wetherall, "Computer Networks", 5th Edition, Pearson Education, 2010
2. Behrouz A.Forouzan,FirouzMosharraf,"Computer Networks: A Top Down Approach",McGraw Hill,1ˢᵗ Edition,2012.

Reference Books
1. LL Peterson, BS Davie, Morgan-Kauffman,"Computer Networks: A Systems Approach", 5th Edition, 2011.
2. JF Kurose, KW Ross, Addison-Wesley, "Computer Networking: A Top-Down Approach",5th Edition, 2009.
3. William Stallings, Pearson,"Data and Computer Communications" , 8th Edition, 2007

Web Resources

1. https://nptel.ac.in/courses/106/105/106105183/
2. https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_networ

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k_pdf_version.htm
3. https://www.javatpoint.com/computer-network-tutorial

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	30
L2	50	70
Total (%)	100	100

L1: Remember

1. List any 2 advantages and disadvantages of mesh topology
2. Define Maximum Data rate of a channel
3. Define Ethernet and Fast Ethernet
4. Define Congestion.
5. Write the general principles of congestion
6. Define TCP & UDP
7. Write the Application layer paradigms.
8. What are the problems with Congestion?
9. What are the design issues of data link layer?
10. What is the significance of DNS?

L2: Understand

1. Explain the structure of UDP Header format.?
2. Illustrate Routing of Packets within Virtual Circuit Subnet.?
3. Explain Traffic Aware Routing?
4. Compare the throughput of pure aloha and slotted aloha.?
5. Explain Channel Allocation strategies?
6. Explain about the sliding window protocol using Go-Back-NA.?
7. Explain Simplex Stop & Wait Protocol?
8. Compare and contrast synchronous time division multiplexing and statistical time division multiplexing.?
9. Explain Signal to Noise Ratio?
10. Explain different Network Topologies.?

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| PC | 20AI405 Artificial Intelligence | | | 3 | 1 | 0 | 3 |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | PO12 | DoK |
		PO1	PO2		
20AI405.1	Describe the foundational principles of artificial intelligence	3	2	1	L1, L2
20AI405.2	Formalise the given problem using different AI methods	3	2	1	L1, L2
20AI405.3	Explain different concepts of logic	3	2	1	L1, L2
20AI405.4	Describe the different methods of knowledge representation	3	2	1	L1, L2
20AI405.5	Explain the priciples and applications of expert systems	3	2	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to Artificial Intelligence
9+3 Hours

Introduction – History - Intelligent systems - Foundations of AI – Applications – Tic-Tac-Tie game playing - Development of AI languages - Current trends in AI

Online agents

Unit II: Problem Solving
9+3 Hours

Problem solving: State-Space search and Control strategies: Introduction - General problem solving - Characteristics of problem - Exhaustive searches - Heuristic search techniques – Iterative deepening A* - Constraint satisfaction - Problem reduction and game playing: Introduction - Problem reduction - Game playing – Alpha beta pruning - Two-player perfect information games

Unknown environment

Unit III: Logic concepts
9+3 Hours

Introduction -Propositional calculus - Proportional logic - Natural deduction system - Axiomatic system - Semantic tableau system in proportional logic - Resolution refutation in proportional logic

Predicate Logic

Unit IV: Knowledge Representation
9+3 Hours

Introduction - Approaches to knowledge representation - Knowledge representation using semantic network - Extended semantic networks for KR - Knowledge representation using frames - Advanced knowledge representation techniques: Introduction - Conceptual dependency theory - Script structure - Cyctheory - Case grammars

Semantic web

Unit V: Expert Systems
9+3 Hours

Expert system and applications: Introduction - Phases in building expert systems - Expert system versus traditional systems - Rule-based expert systems - Blackboard systems - Truth maintenance systems - Application of expert systems

List of shells and tools

Text Books
1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007

Reference Books
1. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
2. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
3. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013

Web Resources
1. https://nptel.ac.in

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Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
1. State the tasks which are associated with A.I.
2. Give an example of script-arithmetic problem.
3. Define Script
4. Recall Intelligence

L2: Understand
1. Explain Turing Test.
2. Explain the characteristics of production system.
3. Write A* algorithm in detail and explain its functionality to solve 8-puzzle problem.
4. Explain the semantic analysis phase done through case grammars in Natural Language understanding

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| PE | 20CS001 Object Oriented Analysis and Design | 3 | 0 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS001.1	Compare and contrast object oriented analysis and design	-	L1, L2
20CS001.2	Create class diagrams that model both the domain model and design model of a software system.	-	L1, L2
20CS001.3	Analyze the conceptual model of UML	-	L1, L2, L3
20CS001.4	Create interaction diagrams and other diagrams that model the dynamic aspects of a software system	-	L1, L2, L3
20CS001.5	Detailed case study experience with architecture, analysis and design.	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction   **9 Hours**
The Structure of Complex systems, The Inherent Complexity of Software, Attributes of Complex System, Organized and Disorganized Complexity, Designing Complex Systems, Foundation of Object Model, Elements of Object Model, Applying the Object Model

Object Model with Case Study

Unit II: Classes and Objects   **9 Hours**
Nature of Object, Nature of Class, Identifying Classes and Objects, Relationships among objects, Relationship among Classes, Interplay of Classes and Objects, Importance of Proper Classification, Key abstractions and Mechanisms

Difference between Class and Object

Unit III: Introduction to UML   **9 Hours**
Why we model, Conceptual model of UML, Architecture, Class diagrams, Object diagrams

Examples of object diagrams

Unit IV: Behavioural Modelling   **9 Hours**
Interactions, Interaction diagrams, Use cases, Use case Diagrams, Activity Diagrams, processes and Threads, state chart diagrams

Examples of state chart diagrams

Unit V: Architectural Modelling   **9 Hours**
Component, Deployment, Component diagrams and Deployment diagrams.
Case Study: Any Software Application covering all Analysis and Design Diagrams

Case study examples

Text Books
1. Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen and Kellia Houston, "Object Oriented Analysis and Design with Applications", 3rd edition, Pearson, 2013
2. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language User Guide", 12th Impression, Pearson, 2012

Reference Books
1. Mahesh P. Matha, "Object-oriented analysis and design using UML", PHI, 2008
2. Brett D. McLaughlin, Gary Pollice, Dave West, "Head first object-oriented analysis and design", O"Reilly, 2006
3. John W. Satzinger, Robert B. Jackson, Stephen D. Burd, "Object-oriented analysis and design with the Unified process", Cengage Learning
4. James Rumbaugh, Ivar Jacobson, Grady Booch, Addison-Wesley, "The Unified modelling language Reference manual",2005

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Web Resources
1. https://www.geeksforgeeks.org/classes-objects-java/
2. https://www.youtube.com/watch?v=sQgoFjxSdxo
3. https://www.tutorialspoint.com/software_architecture_design/architecture_models.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

L1: Remember
1. Define Class and object
1. What is Use case diagram?
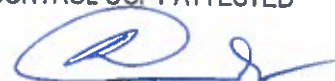2. List 2 Architecture building blocks

L2: Understand
1. Explain Class diagram and object diagram
2. Explain Process and Thread
3. Explain Four kinds of relationships in UML
4. Explain the Elements in object model

L3: Apply
1. Describe about Concurrency and Persistence
2. Explain about Encapsulation and Modularity
3. Describe Multiplicity and Realization in UML

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BS 20BSX15 Probability and Statistics   3   1   0   3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX15.1	Classify the concepts of Statistics and its importance and Interpret Measures of Central Tendency and Dispersion of Data	3	1	L1, L2, L3
20BSX15.2	Identify the suitable discrete and continuous probability distributions to solve various engineering problems	3	1	L1, L2, L3
20BSX15.3	Identify the estimation errors in sampling distributions	3	1	L1, L2, L3
20BSX15.4	Apply the proper test statistics to test the hypothetical data by Tests of Hypothesis	3	1	L1, L2, L3
20BSX15.5	Apply the method of least squares, correlation and regression analysis to fit the curves	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Descriptive statistics methods   11 + 1 Hour
Introduction to Statistics- Population vs Sample -Collection of data primary and secondary data- Data visualization, Measures of Central tendency, Measures of Variability (spread or variance)- Skewness-Kurtosis.

Measures of Dispersion – Range – Quartile
Deviation

Unit II: Probability and Probability Distributions   11 + 1 Hour
Review of probability- Conditional probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

Moment generating
function

Unit III: Sampling Theory   11 + 1 Hour
Introduction – Population and samples – Sampling distribution of Means and variances(Definitions only) – Central limit theorem (without proof) -Introduction to Student's t- Distribution, Chi-square Distribution and F- Distribution Point and Interval Estimations Maximum error of estimate.

Introduction to Sampling, parameters,
statistics.

Unit IV: Tests of Hypothesis   11 + 1 Hour
Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Large samples: Tests concerning one mean and two means - Small samples:
Student t-distribution (test for single mean, two means and paired t-test) - Chi-square test for Single variance- Chi-square - Test for goodness of fit

Test for single proportion, Difference of proportions (Large Samples)

Unit V: Curve Fitting, Correlation and Regression   11 + 1 Hour
Curve fitting: Method of least squares – Straight line – Parabola – Exponential – Power curves.
Correlation: Correlation – correlation coefficient – rank correlation – regression coefficients and properties – regression lines.

Power curves by the method of least
squares

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TextBooks

1. Miller and Freund J. E., "Probability & Statistics for Engineers", 9th Edition, Prentice Hall of India, 2011
2. Iyenger T. K. V., Prasad M. V. S. S. N., Ranganatham S., KrishnaGandhi.B., "Probability & Statistics", 2nd Edition, S. Chand Publications, 2019

Reference Books

1. Arnold O. Allen, "Probability & Statistics", Academic Press, 2nd Edition, 2005
2. Shahnaz Bathul, "A Text Book of Probability & Statistics", 2nd Edition, V. G. S. Book Links, 2nd Edition, 2007
3. Murugesan and Gurusamy, "A Text Book of Probability & Statistics", 2nd Edition Anuradha Publications, 2011

Web References

1. https://nptel.ac.in/courses/111106112/
2. https://nptel.ac.in/courses/111105090/
3. https://nptel.ac.in/courses/111101004/
4. https://nptel.ac.in/courses/111102111/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	10
L2	50	50
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define conditional probability
2. Define Population and Sample
3. Write about Skewness and Kurtosis
4. State Correlation and Regression
5. State Mean and Variance in Sampling Distribution

L2: Understand

1. State and prove Bayes theorem
2. Write the differences of collection of primary and secondary data type of variable
3. Find out the Kurtosis of the data

Class Interval	0 -10	10 - 20	20 – 30	30 - 40
Frequency	1	3	4	2

4. The mean height of students in a college is 155cms and S.D. is 15. What is the probability that mean height of 36 students is less than 157 cms
5. The number of auto mobile accidents per week in a certain community are as follows: 12, 8, 20, 2, 14, 10, 15, 6, 9, 4. Are these frequencies in agreement with the belief that accident conditions were the same during this 10 weeks period

L3: Apply

1. Calculate the regression equation Yon X from the data given below taking deviations from the actual means of X and Y

Price(Rs)	10	12	13	12	16	15
Amount Demanded	40	38	43	45	37	43

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2. The coefficient of Rank Correlation between marks in Statistics and Mathematics obtained by a certain group of students is 0.8. If the sum of the squares of the difference in ranks to be 33. Find the number of students in the group

3. A normal population has a mean of 0.1 and S.D. of 2.1 then find the probability that mean of a sample of size 900 will be negative

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PC **20AI603 Artificial Neural Networks**   3   1   0   3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO3	
23AI603.1	Explain the building blocks and operations of artificial neural networks	3	2	L1, L2
23AI603.2	Explain architecture, taxonomy and functions of several neural networks	3	2	L1, L2
23AI603.3	Describe the structure, function, and applications of single layered feed forward networks	3	2	L1, L2
23AI603.4	Describe the structure, function, and applications of multi layered feed forward networks	3	2	L1, L2
23AI603.5	Describe the principles and implementations of associative memories	3	2	L1, L2

All the COs are by default mapped to PO12 as few topics are inbuilt in syllabus promoting autonomous learning

Unit I: Introduction to Artificial Neural Networks   **9+3 hours**
Introduction, Historical Development of Neural Networks, Biological Neural Networks, Comparison between Biological and Artificial Neural Network, Neural Network Architectures, Building Blocks of Artificial Neural Networks, Artificial Neural Networks Terminologies

Types of Learning
Unit II: Fundamental Models of Artificial Neural Networks   **9+3 hours**
Introduction, McCulloch Pitts Neuron Model, Perceptron Networks, Perceptron Convergence Theorem, BackPropagation, Learning Rules, Adaline and Madaline Networks

Non-linear Separability
Unit III: Self-Organizing Maps   **9+3 hours**
Introduction, Kohenen Self Organizing Networks, Counter Propagation Networks, CPN Building Blocks, Full Counter Propagation Network, Forward-only Counter Propagation Network

Outstar Learning
Unit IV: Adaptive Resonance Theory   **9+3 hours**
Introduction, Adaptive Resonance Theory (ART) Architecture, Basic Operation, Basic Training Steps, ART 1 Architecture and Algorithm, ART 2 Architecture and Algorithm

Learning in ART
Unit V: Associative Memory Networks   **9+3 hours**
Introduction, Algorithms for Pattern Association, Hetero Associative Memory Networks, Auto Associative Memory Networks, Bi-directional Associative Memory

Hopfield Memory

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Text Books

I. S N Sivanandam., S Sumathi., S N Deepa., "Introduction to Neural Networks using MATLAB 6.0", 2ndEdition, Tata McGraw-Hill Publications, 2006

Reference Books

1. Simon Haykin., "Neural Networks",2nd Edition, Pearson Education, 2001
2. James A. Freeman., David M. Skapura., "Neural Networks Algorithms, Applications and Programming Techniques", Addison-Wesley Publications, 2002

Web References

1. https://www.tutorialspoint.com/artificial_neural_network/index.htm
2. https://nptel.ac.in/courses/117/105/117105084/
3. http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture4.pdf
4. https://freebiesglobal.com/artificial-neural-networks-ann-with-keras-in-python-and-r-6
5. http://www.nptelvideos.in/2012/12/neural-networks-and-applications.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Neural Computing
2. Define ANN and Neural Computing
3. List any 4 design parameters in the design of Artificial Neural Network
4. What kinds of transfer functions can be used in each layer?
5. Define Pattern Association
6. What is Adaline Model?
7. What are the types of Learning?
8. What is simple artificial neuron?
9. List any 4 applications of Artificial Neural Network
10. Define Delta Learning rule

L2: Understand

1. Describe on the process of assigning and updating weights in a artificial neural network
2. What are the design steps to be followed for using ANN for your problem?
3. Describe least square algorithm with example
4. Why XOR Problem cannot be solved by a single layer perceptron? Write an alternative solution for it
5. Explain Back Propagation Network with necessary diagrams and equations
6. Write the differences between Hetero Associative Memories and Interpolative Associative Memories

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| PE | **20CS004 Internet of Things** | **3** | **0** | **0** | **3.0** |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS004.1	Outline the IOT Systems in different contexts	-	L1, L2
20CS004.2	Illustrate the Design Principles for Connected Devices	-	L1, L2, L3
20CS004.3	Outline the Design Principles for Web Connectivity	-	L1, L2, L3
20CS004.4	Illustrate the Internet Connectivity Principles, Application protocols & Data Analytics	-	L1, L2, L3
20CS004.5	Design a simple IoT system made up of sensors, wireless network connection	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Internet of Things: An Overview 9 hours
The Internet of Things, IoT Conceptual Framework, IoT Architectural View, Technology behind IoT, Sources of IoT, Machine to Machine Communication

Examples OF Internet of Things

Unit II: Design Principles for Connected Devices 9 hours
IoT/M2M systems layers and designs standardizations, Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway, Ease of designing and affordability

Modified OSI Stack for the IoT /M2M Systems

Unit III: Design Principles for Web Connectivity 9 hours
Introduction, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices

Web sockets

Unit IV: Internet Connectivity Principles 9 hours
Introduction, Internet connectivity, Internet Based Communication, IP Addressing in the IoT, Media Access Control, Application Layer Protocols: HTTP, HTTPS

Data Acquiring, Organising, Processing and Analytics: Introduction, Data Acquiring and Storage, Organizing the Data, Transactions, Business Processes, Integration and Enterprise Systems, Analytics, Knowledge Acquiring, Managing and Storage processes

FTP, TELNET

Unit V: Sensors, Participatory Sensing, RFIDs, and Wireless Sensor Networks 9 hours
Introduction, Sensor Technology, Participatory Sensing, Industry IoT and Automotive IoT, Actuator, Sensor Data Communication Protocols, Radio Frequency Identification Technology, and Wireless, Sensor Network Technology

Case Study: IoT Applications for Smart Homes, Cities

Text Books
1.Rajkamal, "Internet of Things: Architecture and Design Principles", McGraw Hill Higher Education,2017
2.A. Bahgya and V. Madisetti, "Internet of Things", University Press,2015

Reference Books
1.Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", Wiley, 2013
2.Rahul Dubey, "An Introduction to Internet of Things", Connecting devices, Edge Gateway and Cloud with Applications, Cengage, 2019
3.David Hanes, Gonzalo Salgueiro, Patrick Grossetette, rob Barton and Jerome Henry, "IoT Fundamentals, Networking Technologies", Protocols and Use Cases for the Internet of Things, CISCO, Pearson, 2018

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Web Resources
1. https://www.tutorialspoint.com/internet_of_things/index.htm
2. https://www.javatpoint.com/iot-internet-of-things
3. https://www.guru99.com/iot-tutorial.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
1. Define Radio Frequency Identification system? How does it work? Explain
2. Define File Transfer Protocol & Services
3. State Internet-Based Communication does in IoT? Explain in detail
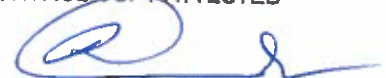4. Define Actuator
5. Define Media Access Control

L2: Understand
1. Explain Web Connectivity for connected-Devices
2. Explain the Application layer Protocols
3. Explain Communication Technologies in detail
4. Explain about Message Communication protocols for Connected Devices
5. Explain about Participatory Sensing

L3: Apply
1. Explain Sensor Network Technology in IoT
2. Discuss the role of Data Analytics in Internet of Things (IoT)
3. Identify the different Sensor Data Communication Protocols

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| PE | 20CS005 Mobile Computing | 3 | 0 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS005.1	Explain the concepts of Mobile Communication.	-	L1, L2
20CS005.2	Describe the concept of GSM in real time applications	-	L1, L2
20CS005.3	Analyze various protocols of all layers for mobile and ad hoc wireless communication networks	-	L1, L2, L3
20CS005.4	Illustrate the IP and TCP layers of Mobile Communication	-	L1, L2, L3
20CS005.5	Explain the different data delivery mechanisms	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction   **9 hours**
Mobile Communications, Mobile Computing – Paradigm, Promises/Novel Applications and Impediments and Architecture; Mobile and Handheld Devices

GSM – Services, System Architecture, Radio Interfaces, Protocols, Localization, Calling, Handover, Security, New Data Services, GPRS

Limitations of Mobile and Handheld Devices

Unit II: (Wireless) Medium Access Control(MAC)   **9 hours**
Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, CDMA ,TDMA, Wireless LAN/(IEEE 802.11)

Differences between SDMA,FDMA,CDMA,TDMA

Unit III: Mobile Network Layer   **9 hours**
IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route Optimization, DHCP,

Entities and Terminologies of Mobile IP

Unit IV: Mobile Transport Layer & Database Issues   **9 hours**
Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks
Database Hoarding & Caching Techniques, Client-Server Computing & Adaptation, Transactional Models, Query processing, Data Recovery Process & QoS Issues

Comparison of Indirect TCP, Snooping TCP, Mobile TCP

Unit V: Data Dissemination and Synchronization   **9 hours**
Communications Asymmetry, Classification of Data Delivery Mechanisms, Data Dissemination, Broadcast Models, Selective Tuning and Indexing Methods, Data Synchronization – Introduction, Software, and Protocols.

Types of Synchronization

Text Books
1. Jochen Schiller, "Mobile Communications", Second Edition, Addison-Wesley, 2009.
2. Raj Kamal, "Mobile Computing", Oxford University Press, 2007

Reference Books
1. Asoke K Talukder, Hasan Ahmed and Roopa R Yavagal, "Mobile Computing, Technology Applications and Service Creation" Second Edition, Mc Graw Hill, 2010
2. UWE Hansmann, LotherMerk, Martin S. Nocklous, Thomas Stober, "Principles of Mobile Computing," Second Edition, Springer, 2006

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Web Resources

1. https://www.tutorialspoint.com/mobile_computing/mobile_computing_quick_guide.htm
2. https://www.slideshare.net/srivaniadudodla/mobile-transport-layer-91529492
3. https://www.slideshare.net/asistithod/mobile-computing-39102507

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

L1: Remember

1. Define MAC
2. What is Multiplexing?
3. What is Foreign Network?
4. What is Mobile node?
5. What is Exposed station problem?

L2: Understand

1. Write any two Wireless LAN Advantages
2. Write two Limitations of Mobile Computing.
3. Write three Goals of GPRS
4. What is the reason for implementing CSMA with CA strategy in Wireless networks?
5. List the specifications of physical medium dependent and its sub layers in IEEE802.11

L3: Apply

1. Write two Design goals of Mobile IP
2. Name the two requirements of Mobile IP and justify them
3. Enlist the three applications of Mobile computing
4. Differentiate guided and unguided media transmission
5. Give the basic packet structure of an IEEE 802.11MAC

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OE **20CEO01 Urban Environmental Services**   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO6	PO7	PO12	
20CEO01.1	Identify urban – health relationships	3	3	1	L1, L2
20CEO01.2	Demonstrates the connection between urban built form and health outcomes	3	3	1	L1, L2
20CEO01.3	Discuss the distribution of health risks of urban transportation grid	3	3	1	L1, L2
20CEO01.4	Assess and plan for community needs in health-care infrastructure	3	3	1	L1, L2
20CEO01.5	Identify preliminary opportunities for advancing urban health outcomes	3	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Health and Planning   9 Hours
Introduction, The Historical Link, Dividing Health and Planning, Urban Health – Basic Conceptions in the Literature, Urban Form, Physical Activity.

Health Promotion

Unit II: Built Urban Form and Health   9 Hours
Renewing the Health-Urban Link, The Urban form, The Metropolitan Sprawl Index, Using Measured Urban Forms to Assess Health Effects, Environmental Factors and Physical Activity

Alternatives to Metropolitan Sprawl Index

Unit III: Transportation Systems   9 Hours
Transport Planning, Private Motor Vehicles as Health Risks, Private Motor Vehicles and Obesity, Public Transport, Mixed-use Medium-density and Pedestrian Travel, Proximity and Individual Factors.

Residential and Travel Preferences

Unit IV: Spatial Access to Health Services   9 Hours
Introduction, The Concept of Access, Dimensions of Spatial Access, Primary Care Supply and Access, Spatial Access and Travel Behaviour, Access and Mortality.

Access to health care Aligned with Transport

Unit V: Challenges and Opportunities   9 Hours
Introduction, Challenges, Conceptual Frameworks, Investigative Methods and Data Collection, Limited Policy Capacity, Fragmented Initiatives, Opportunities, Interdisciplinary Engagement, Major Conceptual Programs, Priorities for future Research.

Promotion of physical activity in daily routines

Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. George Luber and Jay Lemery, "Global Climate Change and Human Health", 1st Edition Jossey-Bass, 2015

Reference Books

1. Pataki, Diane E., et al. "Coupling biogeochemical cycles in urban environments: ecosystem services, green solutions, and misconceptions" Frontiers in Ecology and the Environment, 2011
2. Frank, L., Engelke, P., and Schmid, T., "Health and Community Design: The Impact of The Built Environment on Physical Activity", Island Press, Washington, D.C., 2003
3. Eiichi Taniguchi, Tien Fang Fwa and Russell G Thompson, "Urban Transportation and Logistics", CRC Press, 2014

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Web References

1. https://www.oecd.org/health/health-systems/32006565.pdf
2. https://www.pdfdrive.com/urban-environment-proceedings-of-the-10th-urban-environment-symposium-e157051203.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

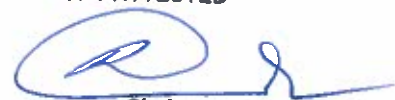**Sample Short and Long Answer Questions of Various Cognitive Levels**

L1: Remember

1. How is natural environment different from urban environment?
2. How does the urban environment affect health and well-being?
3. How can urban areas improve health?

L2: Understand

1. Explain the most important problem related to health in urban area
2. Describe the differences between physical activity for transportation and physical activity for recreation
3. Consider a study that evaluates the health of people in two communities, one with sidewalks and one without. The study authors find that the rate of lung cancer is higher in the community without sidewalks, and conclude that sidewalks protect against lung cancer. What concerns would you have about accepting this conclusion?

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OE   20CSO01 Data Structures and Algorithms   3   0   0   3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CSO01.1	Understand the advanced data structures and algorithms	-	L1, L2, L3
20CSO01.2	Demonstrate through abstract properties of various data structures such as stacks, queues and lists to implement efficient programs using data structures.	-	L1, L2, L3
20CSO01.3	Demonstrate through various searching & sorting techniques	-	L1, L2, L3
20CSO01.4	Apply data structures and algorithms to solve real world problems.	-	L1, L2, L3
20CSO01.5	Apply algorithm analysis techniques to evaluate the performance of an algorithm.	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Data Structures & Algorithms   9 hours
Introduction to Data Structure, Data Organization, Abstract Data Types, Elementary data types; Basic concepts of data Structures; performance measures for data structures, Time and Space Complexity. Introduction to Algorithms, Asymptotic notations and common functions, Algorithm Specifications: Performance Analysis and Measurement

Efficiency of an Algorithm

Unit II: Arrays and Linked Lists   9 hours
Arrays- Definition, Different types of Arrays, Application of arrays, Sparse Matrices and their representations.   Linked lists- Definition, Implementation of Singly Linked Lists, Doubly Linked List, Operations on a Linked List, Insertion, Deletion and Traversal. Stack-Basic Concept of Stack, Stack as an ADT and operations in stack. Queue-Basic Concept of Queue, Queue as an ADT and Operations in Queue

Generalized Linked List, Applications of Stack and Queue   9 hours

Unit III: Trees and Graphs
Trees- Basic concept of Binary tree, Operations in Binary Tree, Tree Height, Level and Depth, Binary Search Tree, Insertion, Deletion, Traversals, Search in BST, 2-4 trees. Graph-Matrix Representation Of Graphs, Elementary Graph operations(Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree)

Applications of Tress and Graph

Unit IV: Algorithm Design Techniques I   9 hours
Divide and Conquer-General method, Merge sort, Quick sort. Brute force- approach, bubble sort, Linear Search techniques.

Preferences of Merge and quick sort techniques.

Unit V: Algorithm Design Techniques II   9 hours
Greedy Technique, General method, Knapsack problem, Job sequencing with deadlines, Minimal cost spanning tree algorithms (Prim's and Kruskal's), Dynamic Programming: General method, 0/1 knapsack problem, All pair shortest path algorithm

Usages of Greedy algorithms.

Text Books
1.   Reema Thareja, "Data Structures Using C", Second Edition, Oxford, 2014
2.   Horowitz, Sahni and Anderson Freed, "Fundamentals of Data Structures in C", Second Edition, 2008
3.   Mark Allen Weis , "Data Structures and Algorithm Analysis in C", Second edition, Pearson, 1997

Reference Books
1.   Salaria R.S., "Data Structures and Algorithms using C", Fifth Edition, Khanna Publishing, 2018
2.   Richard F Gilberg, "Data Structures: A PseudoCode Approach With C++" Fifth edition, Thomson Press(India), 2004
3.   Amitava Nag and Jyothi Prakash Singh, "Data Structures and Algorithms Using C", Second Edition, Vikas Publishing, 2009

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Web References

1. https://www.springboard.com/library/software-engineering/data-structures-and-algorithms/
2. https://www.geeksforgeeks.org/data-structures/
3. https://www.programiz.com/dsa

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
1. Describe Data Structure and Algorithm
2. Illustrate some applications of stack
3. Describe about a Queue
4. List two applications of Data Structures

L2: Understand
1. Classify data structures
2. Explain about asymptotic notations
3. Differentiate Linked List, Stack and Queue
4. Explain about different sorting algorithms

L3: Apply
1. Implement the append method, which should add a new element onto the tail of the linked list
2. Implement stack using arrays and linked lists
3. Implement Queue using arrays and Linked Lists
4. Illustrate the importance of recursion

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| OE | 20AIO01 Machine Learning for Engineers | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20AIO01.1	Describe different types of learnings		L1, L2
20AIO01.2	Explain different supervised learning algorithms		L1, L2
20AIO01.3	Explain different unsupervised learning algorithms	-	L1, L2
20AIO01.4	Describe various types of machine learning models		L1, L2
20AIO01.5	Choose appropriate machine learning model and algorithm for given task		L1, L2

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to learning   9 hours
Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression

Examples of regression

Unit II: Linear Models   9 hours
Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

Applications of perceptron

Unit III: Trees and Probabilistic Models   9 hours
Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbour Methods – Unsupervised Learning – K means Algorithms – Vector Quantization

Self-Organizing Feature Map

Unit IV: Dimensionality Reduction and Evolutionary Models   9 hours
Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms

Markov decision process

Unit V: Graphical Models   9 hours
Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models

Tracking Methods

Text Books
1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2013

Reference Books
1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", 1st Edition, Cambridge University Press, 2012.
2. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", 1st Edition, Wiley, 2014

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3. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", 3rd Edition, MIT Press, 2014

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
1. Define Machine Learning.
2. List the types of Machine Learning.
3. State Bayes Theorem.
4. What is Regularization?

L2: Understand
1. Demonstrate Linear Regression.
2. Explain Back Propagation Algorithm.
3. Illustrate Decision Tree Induction process
4. Explain Genetic Operations with examples

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| OE | **Introduction to Database Management Systems** | 3 | 0 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Pos	DoK
20DSO01.1	Describe the basic concepts of DBMS And different data models		L1,L2
20DSO01.2	Apply Constrains on relations		L2,L2,L3
20DSO01.3	Apply SQL commands on relations	-	L1,L3
20DSO01.4	Understand PL/SQL operations		L1,L2,L3
20DSO01.5	Understand the principles of database normalization and Transaction management system.		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction to Databases   **9 Hours**
Overview of Data Base Systems, Database System Applications, File System VS Database System, Data Abstraction, Levels of Abstraction, Data Independence Instances and Schemas, Different Data Models, Database Languages, Data Base Users and Administrator, Database System Structure, N-tier Architecture, Database design and ER diagrams, Design Entities, Attributes and Entity sets, Relationships and Relationship Sets, Advanced Features of ER Model

History of DBMS

Unit II: Relational Model, Relational Algebra and Relational calculus   **9 Hours**
Relational Model: Introduction to the Relational Model, Integrity Constraint and key constraints over relations, Logical data base Design, Views, Destroying / Altering Tables and Views - Relational Algebra: Selection and Projection, Set Operations, Aggregate Operations, Renaming, Joins,
Division, Additional Relational Algebraic operations - Relational calculus: Tuple Relational Calculus, Domain Relational Calculus

Expressive Power of Algebra and Calculus

Unit III: Structured Query Language   **9 Hours**
SQL: Concept of different Database Languages over SQL - DDL, DML, DCL., Set operations, SQL Commands, Nested queries, Aggregate Functions, Null Value, Referential Integrity Constraints, views.

Compare all Database Languages

Unit IV: Schema Refinement and Normalization   **9 Hours**
Understand PL/SQL block, components of PL/SQL block, Control statements and conditional statements in PL/SQL Embedded SQL, Triggers, Cursors, Stored procedures packages

Compare all Normal Forms

Unit V: Normalization   **9 Hours**
Understand the principles for Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure Set of
Functional Dependencies, Closure Set of Attributes. - Normalization: 1NF, 2NF, 3NF, BCNF, Lossless Join and Dependency Preserving decomposition,
4NF and 5N. Transaction Concept, ACID Properties, States of Transaction, Implementation of Atomicity & Durability, Schedules,

Concurrency Control without Locking

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Text Books

1. Abraham Silber Schatz, Henry F Korth, S Sudarshan, "Database System Concepts", 6th Edition, McGraw-Hill International Edition, 2013
2. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database Systems", 8th Edition, PearsonEducation, 2006
3. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", 3rd Edition, TATA McGraw Hill, 2008

Reference Books

1. Elmasri Navrate, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016
2. Peter Rob & Carlos Coronel, "Data base Systems design, Implementation, and Management", 10th Edition, Pearson Education, 2013

Web References

1. https://www.javatpoint.com/dbms-tutorial
2. https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system-set-1/?ref=lbp

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	30	40
L3	40	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List types of database users
2. List out all types of data models present
3. Give syntaxes to Create and Alter a table
4. What is Redundancy?
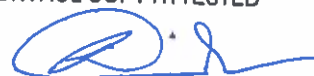5. List out the properties of transactions

L2: Understand

1. Compare the database system with conventional file system
2. Demonstrate the use of DISTINCT keyword in SQL select statement
3. Explain the following SQL constructs with examples:

(1) Order by (2) group by and having (3) as select (4) schema

4. Explain the difference among Entity, Entity Type & Entity Set
5. Illustrate ACID properties

L3: Apply

1. Choose a relation R with 5 attributes ABCDE and the following FDs: A ->B, BC->E, and ED ->A. Is R in 3NF? Justify?
2. Apply Normalization technique for the following relation up to 3NF:

Bank (acno, cust_name, ac_type, bal, int_rate, cust_city, branchId, branch_nm, br_city)

3. Construct a transaction state diagram and describe each state that a transaction goes through during its execution?
4. Demonstrate serializabulity concept

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OE	**20ECO01 Architectures and Algorithms of IoT**	**3**	**0**	**0**	**3**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20ECO01.1	Demonstrate the Architecture and applications of IoT		L1, L2
20ECO01.2	Explain the protocol concept and data bases of IoT		L1, L2, L3
20ECO01.3	Construct the IoT device design space and Platform design		L1, L2, L3
20ECO01.4	Explain the IoT network model and Event analysis		L1, L2, L3
20ECO01.5	Demonstrate the Industrial Internet of Things and its Architecture		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: The IoT Landscape   **12 Hours**
What Is IoT?, Applications , Architectures , Wireless Networks, Devices, Security and Privacy , Event-Driven Systems.

Ethernet

Unit II: IoT System Architectures   **10 Hours**
Introduction, Protocols Concepts, IoT-Oriented Protocols, Databases, Time Bases, Security.

Message Queuing Telemetritransport (MQTT)

Unit III: IoT Devices   **12 Hours**
The IoT Device Design Space, Cost of Ownership and Power Consumption, Cost per Transistor and Chip Size, Duty Cycle and Power Consumption.

Platform Design

Unit IV: Event-Driven System Analysis   **14 Hours**
IoT Network Model - Events, Networks, Devices and Hubs, Single-Hub Networks, Multi-hub Networks, Network Models and Physical Networks, IoT Event Analysis - Event Populations, Stochastic Event Populations, Environmental Interaction Modeling.

Event Transport and Migration

Unit V: Industrial Internet of Things   **12 Hours**
Introduction, Industrie 4.0, Industrial Internet of Things (IIoT), IioT Architecture, Basic Technologies, Applications and Challenges.

Integrated IIoT

Textbooks

1. Dimitrios Serpanos and Marilyn Wolf, "Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies", Springer, Cham, 2018
2. Vijay Madisetti and Arshdeep Bahga, " Internet of Things (A Hands-on Approach)", Universities Press, 2015

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Reference Books

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons Ltd, UK, 2014
2. Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", John Wiley and Sons Ltd., UK, 2012

Web Resources

1. https://books.google.co.in/books?isbn=1119969093
2. https://books.google.co.in/books?isbn=135123093X

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is IoT?
2. List any three applications of IoT
3. Define protocol concept of IoT
4. Define data base
5. What is Duty cycle?

L2: Understand

1. Explain the Architecture of IoT
2. Explain the Security and privacy of IoT
3. Illustrate the Protocol Concept of IoT
4. Explain the Date bases of IoT
5. Demonstrate the IoT Device Design Space

L3: Apply

1. Identify the Wireless Networks for IoT
2. Model the Event-Driven Systems for IoT
3. Construct the IoT-Oriented Protocols
4. Construct the Platform Design for IoT

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| OE | **20EEO01 Introduction to Renewable Energy Sources** | 3 | 0 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's		DoK
		PO1	PO7	
20EEO01.1	Understand the significance of solar energy	2	2	L1, L2
20EEO01.2	Provide the importance of Wind Energy	2	2	L1, L2
20EEO01.3	Understand the role of ocean energy in the Energy Generation	3	2	L1, L2
20EEO01.4	Explain the utilization of Biogas plants and geothermal energy	2	2	L1, L2
20EEO01.5	Explain the concept of energy Conservation	2	2	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Solar Energy   12 Hours
Solar Radiation, Measurements of Solar Radiation, Flat Plate And Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar , Photo Voltaic Conversion, PV Characteristics Solar Cells, Solar PV Power Generation, Solar PV Applications.

Thermal analysis of flat plate collectors

Unit II: Wind Energy   12 Hours
Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Wind Turbine Generator

Betz Criteria

Unit III: Ocean Energy   12 Hours
Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants

Open and closed OTEC Cycle

Unit IV: Bio Mass   12 Hours
Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gasdigesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

I.C Engine Operation

Unit V: Geo Thermal Energy and Energy Conservation   12 Hours
Resources, types of wells, methods of harnessing the energy, scope in India. Principles of energy conservation, the different energy conservation appliances, cooking stoves, Benefits of improved cooking stoves over the traditional cooking stoves

Hydro Thermal, Geo-pressured, Hot dry rocks

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Text Books

1. R K Gupta and S C Bhatia "Renewable Energy" Woodhead publishing India Pvt. Ltd.,2019
2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Second Edition, IEEE Press, Wiley, 2013
3. Ranjan Rakesh, Kothari D. P.& Singal K. C., "Renewable Energy Sources And Emerging Technologies", 2 nd Edition, PHI, 2013
4. Mukund R. Patel, "Wind and Solar Power Systems – Design, Analysis and Operation", 2nd Edition, Taylor & Francis, 2006

Reference Books

1. S Sukhatme, J Nayak, "Solar Energy: Principles of Thermal Collection and Storage", 3rd Edition, Tata Mcgraw Hill , 2003.
2. Tiwari and Ghosal, "Renewable energy resources", 2nd edition, Narosa Publishing house, 2001
3. B H Khan, "Non conventional energy resources", 2 nd Edition, Tata Mcgraw Hill, 2001

Web References

1. https://nptel.ac.in/courses/121/106/121106014/
2. https://www.edx.org/learn/renewable-energy
3. https://www.coursera.org/learn/renewable-energy-resources-and-technologies

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	30
L2	60	70
Total (%)	100	100

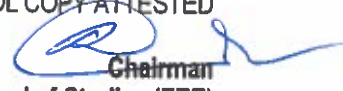## Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is meant by Solar Thermal Energy?
2. Give the classification of small hydro power stations.
3. What are the various losses occurring in the fuel cell?
4. List various Biomass resources.
5. What is the basic principle of Tidal Power?

L2: Understand

1. Explain in detail about flat plate collectors and give its advantage and disadvantages.
2. Explain the principle of working of a H2 - O2 fuel cell.
3. Explain about Dry, Wet and Hot water Geo thermal systems.
4. Compare between Geo thermal power plant and Conventional thermal power plant.
5. Explain about the site requirements to construct a Tidal Power Plant.

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OE **20MEO01 Nano Technology**   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes	DoK
20MEO01.1	*Describe* the fundamental science of nanomaterials	L2
20MEO01.2	Demonstrate the preparation of nanomaterials	L1,L2
20MEO01.3	Explain of the challenges on safe nanotechnology	L1,L2
20MEO01.4	Develop knowledge in characteristic nanomaterial	L1,L2,L3
20MEO01.5	Apply Nanoscience for industrial applications	L1,L2,L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction
11+1 Hours

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.

Introduction to properties and motivation for study (qualitative only)

Unit II: General Methods Of Preparation
11+1 Hours

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation.

Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE

Unit III: Nano materials
11+1 Hours

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires.

Quantum dots-preparation, properties and applications

Unit IV: Characterization Techniques
11+1 Hours

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA.

SIMS-Nano-indentation

Unit V: Applications
11+1 Hours

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition.

Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TEXT BOOKS:
1. Edelstein A.S and Cammearata R.C, Eds., "Nanomaterials: Synthesis, Properties And Applications", Institute Of Physics Publishing, Bristol And Philadelphia, 1996.
2. John Dinardo N, "Nanoscale Characterization Of Surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000
3. Murthy B.S and Shankar P, " Nanoscience and NanoTechnology" , 1st Edition, Springer Publications,2013
4. Louis Hornyak and Tibbals H F, " Introduction to Nanoscience and NanoTechnology" , 1stEdition,Tailor Francis CRC Press,2008

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REFERENCE BOOKS:

1. Timp G, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Web references:

1.http://www.nano.gov
2.http://mrsec.wisc.edu/edetc/IPSE/links.html
3.http://nptel.ac.in/courses/112105182/9
4.IOPSCIENCE—Nanotechnology

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	60	20
L2	40	40
L3	-	40
L4	-	-
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1.What is Nano technology?

2.How does Nano Technology Works?

3.What are Nano Materials?

4.Who is Developing Nano technology?

L 2: Understand

1. What Are Some Of The Most Interesting Nanoparticles Found In Nature (Not Manufactured In The Lab)?

2. Given The Nano-Size Of The Particles, Are There Any Effective Respirator Filters To Guard Against Inhalation?

3. What Do You Feel The Repercussions Are For Extended Life Through Utilization Of Nanotechnology?

4. What Is The Risk Of Not Developing Nanotech (In Health Care, Environmental Protection, Economic Development)?

L 3: Applying

1.How are safety tests carried out in nano tech?

2. Seems that (nano)tech is moving fast. Is there a risk that results of safety testing will be out-of-date as soon as printed? How to keep up pace?

3. Discuss about targeted drug delivery using nanoparticles.

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OE 20SHO01 Women and Society

3	0	0	3

Code	Course Outcomes	Mapping with POs	DoK
20SHO01.1	This course aims to generate awareness on various factors that constructs and shapes gender identity and perpetuates gender discrimination.		L1,L2
20SHO01.2	This course aims to generate awareness on various factors that constructs and shapes gender identity and perpetuates gender discrimination.		L1,L2
20SHO01.3	The course will examine how feminist analysis & methodology redefines traditional categories and disciplinary concepts through its attention to gender as a social category		L1,L2
20SHO01.4	The course further aims to sensitize students on emerging areas of gender discrimination and its possible resolution		L1,L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Objectives:

This course aims to generate awareness on various factors that constructs and shapes gender identityand perpetuates gender discrimination.

UNIT -I WOMEN AND SOCIETY   9 Hours

Understanding Sex- Gender, Gender shaping Institutions, Theories of Gender construction Understanding Sexism and Androcentrism, Understanding Patriarchy and Theories of Patriarchy, Privateand Publicdichotomy, Sexual Division of Work, Patriarchy practices in different institutions and Text Books.

UNIT -II FEMINIST THEORY   9 Hours

Rise of Feminism, Introduction to various stands of Feminism- Liberal Feminism, Radical Feminism, Marxist Feminism, Socialist Feminism, Cultural Feminism, Eco-Feminism, Post-Colonial Feminism, and Post Modern Feminism. Waves of Feminism.

UNIT -III WOMEN'S MOVEMENT   9 Hours

The socio-economic conditions of women during the age of Industrial revolution the Call for Women's Rights 1848, Women's rights movement 1848-1920, Historical Developments of Social Reform Movements in India, Women's groups and organizations, Women's Movement Movements for UniformCivil code and ShahBano case, Dalit women and the question of double marginality.

UNIT –IV GENDER ROLES AND PSYCHOLOGY OF SEX   9 Hours

Difference Conceptualization of gender roles and gender role attitudes, Gender: Aggression, Achievement, Communication, Friendship and Romantic, Relationships Sex Differences in Mental Health Trauma relating to Rape, Taboo, Childhood Sexual Abuse, Domestic Violence, Sexual Harassment at Work Place, Educational Institutions, Eve Teasing etc.

UNIT – V GENDER AND REPRESENTATION   9 Hours

Gender and Mass Media- Print Media, Gender and Mass Media-Electronic Media, Gender and Films, Advertisements, Mega Serials, Stereotyping and breaking the norms of women's roles Women's Representation in Literary Texts.

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Suggested reading:

1. Basabi Chakrabarti, Women's Studies: Various Aspects. Urbi Prakashani, 2014
2. Arvind Narrain.Queer:Despised Sexuality Lawand Social Change.Book for Change,2005
3. Chandra Talpade Mohanty, Feminism without Borders:DecolonizingTheory, Practicing Solidarity. Duke University Press.
4. Flavia Agnes.Lawand Gender Inequality:The Politics of Women's Rights in India.Oxford University Press,2001
5. Sonia Bathla, Women, Democracy and the Media: Cultural and Political Representations in the Indian Press,Sage,NewDelhi,1998.

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PC **20CS506 Java Programming Lab**   0   0   3   1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO4
20CS506.1	Illustrate the usage of classes & object	3
20CS506.2	Implement Inheritance, Method overloading, overriding & Abstract Classes	3
20CS506.3	Implement interfaces, packages, exception handling & Multithreading	3
20CS506.4	Demonstrate the usage of Applets & Event handling	3
20CS506.5	Implement AWT Components	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

List of Experiments

1. a)Write a program to demonstrate the usage of Arrays
   b) Write a program to illustrating Methods
2. Write a program to demonstrate the usage of classes & object
3. Write a JAVA Program that illustrates the following:
   i. Super   ii. Final   iii. Static
4. a) Create a multilevel inheritance for classes vehicle, brand and cost. The vehicle class determines the type of vehicle which is inherited by the class brand which determines the brand of the vehicle. Brand class is inherited by cost class, which tells about the cost of the vehicle. Create another class which calls the constructor of cost class and method that displays the total vehicle information from the attributes available in the super classes.
   b) Create an abstract class shape. Let rectangle and triangle inherit this shape class. Add necessary functions.
5. a) Write a JAVA program illustrate class path
   b) Write a case study on including in class path in your os environment of your package. c) Write a JAVA program that import and use the defined your package in the previous Problem
6. a)Write a program to illustrate the usage of try, catch, throws and finally.
   b)Write an application that shows how to create a user-defined exception
7. a)Write a program to create the threads by extending Thread class.
   b) Write a program that executes two threads. One thread displays every 1000 milliseconds and other displays every 3000 milliseconds.
8. a)Write a program to demonstrate thread synchronization.
   b)Write a program to demonstrate thread priorities.
9. a)Write a Java program to count the number of occurrences of a character in a given string.
   b) Write a Java program to merging of two strings
10. a) Write Applet code for drawing line, rectangle, circle and setting color
    b) Write a program to design a calculator by using Grid Layout
11. Write a program to illustrate the usage of AWT Components

Reference

1. Lab Manual for Java Programming Lab Department of Computer Science and Engineering, NSRIT

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PC **20CS507 Computer Networks Lab**   0   0   3   1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		
		PO1	PO4	PO12
20CS507.1	Illustrate the functions of different networking hardware.	3	3	1
20CS507.2	Implement different Data link layer protocols.	3	3	1
20CS507.3	Implement different Network layer protocols.	3	3	1
20CS507.4	Implement the various Routing protocols/Algorithms	3	3	1
20CS507.5	Implement different Application layer protocols.	3	3	1

1.   Weakly Contributing | 2.ModeratelyContributing |3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create.

List of Experiments

1. Study of Networking hardware and the network setup in the campus.
2. Implement the data link layer framing methods such as character stuffing and bit stuffing.
3. Write a program to simulate the sliding window protocol for Go Back-n
4. Write a program to simulate the sliding window protocol for Selective Repeat
5. Write a program to simulate the stop and wait protocol
6. Write a client-server application for chat using UDP
7. Implementation of one-to-onechat application.
8. Implementation of Connection oriented concurrent service (TCP).
9. Simulate the OPEN SHORTEST PATH FIRST routing protocol based on the cost assigned to the path.
10. Implement Dijkstra's algorithm to compute the shortest path in a graph.
11. Take an example subnet graph with weights indicating delay between nodes. Now obtain Routing table art each node using distance vector routing algorithm.
12. Implementation of FTP.
13. Implementation of SMTP.

References

1. Lab Manual for Network Programming Lab, Department Computer Science & Engineering, NSRIT.

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SC **Technical Paper Writing**   **0   0   4   2.0**

At the end of the course, students will be able to

No.   Course Outcomes

1   Develop searching latest relevant literature pertaining to the topic of interest
2   Develop self-learning ability to become a lifelong independent learner
3   Develop the habit of writing technical manuscript as per the requirement
4   Develop presentation skills and speak with appropriate technical phrases
5   Explore the research topics and develop research interests
6   Comprehend the latest technologies, techniques, tools, and methodologies

Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes

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20MCX03 Intellectual Property Rights and Patents   2   0   0   0.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO11	PO12	
20MCX03.1	Acquire knowledge on intellectual property rights	-	-	L1, L2
20MCX03.2	Know about the acquisition of trademarks	-	-	L1, L2
20MCX03.3	Identify the importance of copyrights, patents and transfer of ownership	-	-	L1, L2
20MCX03.4	Reciprocate to new developments of intellectual property rights	-	-	L1, L2
20MCX03.5	International overview of IPR	-	-	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Intellectual property: 4 Hours

Concepts, types of intellectual property,international organizations, agencies and importance of intellectual propertyrights.IndustrialProperty,technologicalResearch,InventionsandInnovations – Important examples of IPR.,IPR in India and Abroad

Unit II: Introduction toTrade Marks: 4 Hours

Purpose and function of trademarks, acquisition of trade markrights,selecting and evaluating trademark ,trademark registration processes.Trade Secrets and Industrial Design registration in India and Abroad

Unit III: Registration of Copy Rights   4 Hours

Fundamentals of copy right law,rights of reproduction, rights to perform the work publicly, copy right ownership issues, copyrightregistration, international copyright laws.
Law of patents: Foundation of patent law, patent searching process, ownership rights andtransfer.

Unit IV: Latest development of intellectual property Rights   4 Hours

New developments in trademark law; copy right law, patent law, intellectual property audits, Infringement of IPRs,Enforcement Measures,Emerging issues

Unit V:Enforcement Of IPRs   4 Hours
International overview on intellectual property, international – trade mark law, copy right law, international patent law international development in trade secrets law

Text Books

1. Deborah., E. Bouchoux, "Intellectual Property Right", Cengage learning
2. Prabuddha Ganguli,TataMcGraw Hill, Intellectual property right - Unleashing the knowledge economy, Publishing Company Ltd.
3. Cornish, William Rodolph & Llewelyn, David, Intellectualproperty:patents, copyright, trademarks andallied rights. Sweet& Maxwell,8/e,2013.

Reference Books

1. Cornish, William Rodolph. Casesandmaterialsonintellectualproperty.Sweet&Maxwell, 5/e,2006.
2. Lo,JackandPressman,David.Howtomakepatentdrawings:apatentityourselfcompanion. Nolo, 5/e 2007.

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Web References

1. https://www.investopedia.com/terms/i/intellectualproperty.asp
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3217699/
3. https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	60	60
Total (%)	100	100

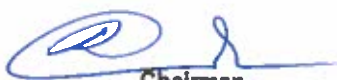**Sample Short and Long Answer Questions of Various Cognitive Levels**

L1: Remember

1. What is Industrial property?
2. What are the fundamentals of copy rights
3. Define patents and its approval process
4. Define copy right law.
5. Define transfor of trade marks.

L2: Understand

1. Explain the role trade scerets in company law.
2. Explain the concept owenership rights of patents with suitable examples
3. Explain the international patent law.
4. Distinguish between copy rights and patents.
5. Explain copt right registration.

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IN   **Summer Internship #1 / CSP**   **0   0   0   1.5**

At the end of the course, students will be able to

No.   Course Outcomes

1   Demonstrate the theoretical learning outcomes
2   Integrate theory and practice during graduation
3   Comprehend the industry practices in the relevant and allied field of study
4   Develop communication skills in terms of oral, written, and graphical communications
5   Develop problem solving skills
6   Develop work habits and teamwork in a multidisciplinary setting for a successful career after graduation

Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes

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| PC | **20CS601 Cryptography and Network Security** | | **3** | **0** | **0** | **3.0** |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PO12	
20CS601.1	Understand basics of cryptography and network security.	3	1	1	1	L1, L2
20CS601.2	Understand the concepts of Confidentiality, Integrity and Availability of a data	3	1	1	1	L1, L2
20CS601.3	Implement different public key cryptography techniques	3	1	1	1	L1, L2, L3
20CS601.4	Apply various protocols for network security	3	1	1	1	L1, L2, L3
20CS601.5	Understand the concepts of web and system security	3	1	1	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UNIT I: Introduction 9 hours
Security Attacks, Services and Mechanism, Cryptography, Conventional Encryption Model, Classical Encryption Techniques, Substitution Ciphers and Transposition Ciphers, Cryptanalysis, Steganography, Stream and Block ciphers, Block ciphers principals, Data Encryption Standard(DES), Strength of DES, Differential and Linear Crypt Analysis of DES, Block cipher modes of operations, Triple DES, AES

Differences between DES and AES

Unit II: Confidentiality and Modular Arithmetic 9 hours
Confidentiality using Conventional Encryption, Traffic confidentiality, Key distribution, Random number generation, Graph, Ring and field, Prime numbers, modular arithmetic, Fermat's and Euler's theorem, Primality testing, Euclid's Algorithm, Chinese Remainder theorem, Discrete algorithms

Relative prime numbers

Unit III: Public key cryptography and Authentication requirements 9 hours
Principles of Public Key crypto systems, RSA algorithm, Security of RSA, Key management, Diffie-Hellman key exchange algorithm, Elliptic Curve cryptography, Authentication functions, Message authentication code Hash functions, Birthday attacks, Security of hash functions and MACS.

Authentication requirements

Unit IV: Integrity checks and Authentication algorithms 9 hours
Message digest algorithm(MD5), Secure hash algorithm (SHA), Digital Signatures, Authentication protocols, Digital Signature Standards (DSS), Proof of digital signature algorithm, Kerberos and X.509, Directory authentication service, Electronic mail security, Pretty good privacy (PGP) - S/MIME.

Differences between MD5 and SHA

Unit V: Web and System Security 9 hours
Web Security, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction (SET), System Security, Intruders, Viruses and related threads, Firewall design principals – Trusted Systems

Types of Viruses

Text Books

1. William Stallings, "Cryptography and Network security Principles and Practices", seventh edition, Pearson, 2017
2. Behrouz A Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", third edition, McGraw-Hill, 2007.

Reference Books

1. Mao M., "Modern Cryptography – Theory and Practice", Pearson Education, 2008
2. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", second edition, Pearson, 2005.

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Web Resources

1. http://nptel.ac.in/courses/106105031/
2. https://www.tutorialspoint.com/cryptography/index.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is meant by intrusion detection system?
2. What is a web based attack?
3. State Euler's Theorem
4. Write a short note on Triple DES
5. List out any four disadvantages of double DES

L2: Understand

1. Explain the digital signature algorithm
2. Explain in detail the operation of Internet Key Exchange with an example
3. Discuss the various principles involved in private and public key cryptography
4. Explain Data Encryption standard (DES) in detail
5. Explain the Key Expansion process in AES

L3: Apply

1. Apply decryption and encryption using RSA algorithm with p=3, q=11, e=7 and N=5
2. What is the cipher text if the plain text is 63 and public key is 13? Use RSA algorithm
3. State the Chinese Remainder Theorem and find X for the given set of congruent equations $X \equiv 2 \bmod 3$, $X \equiv 3 \bmod 5$ and $X \equiv 2 \bmod 7$
4. Explain the process of deriving eighty 64-bitwords from 1024 bits for processing of a single blocks and also discuss single round function in SHA-512 algorithm. Show the values of W16, W17, W18 and W19
5. How is GCD calculated with Euclid's algorithm? Calculate the GCD of (270, 192)

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PC **20CS602 Web Technologies**   3   0   0   3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PO12	
20CS602.1	Create a web page using HTML and Cascading Styles sheets	3	1	1	1	L1, L2
20CS602.2	Build dynamic web pages using JavaScript (Client side programming).	3	1	1	1	L1, L2
20CS602.3	Create XML documents and Schemas	3	1	1	1	L1, L2, L3
20CS602.4	Build web applications using PHP and MYSQL	3	1	1	1	L1, L2, L3
20CS602.5	Design Web Applications using Ruby and Rails	3	1	1	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: HTML and CSS   **9 hours**

HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Html styles, Elements, Attributes, Heading, Layouts, frames, Images, Hypertext Links, Lists, Tables, Forms, GET and POST method, HTML 5, Dynamic HTML.
CSS: Cascading style sheets, Levels of Style Sheets, Style Specification Formats, Selector Forms

Conflict Resolution,CSS Math functions

Unit II: JavaScript   **9 hours**

The Basics of Java script: Objects, Primitives Operations and Expressions, Screen Output and Keyboard Input, Control Statements, Object Creation and Modification, Arrays, Functions, , Pattern Matching using Regular Expressions, Events and Event Handling, Handling Events from Body Elements, Handling Events from Button Elements, validations

Constructors, Errors in Scripts

Unit III: XML   **9 hours**

The Syntax of XML, Document type Definition, XML schemas, XML Namespace, Document object model, XSLT, DOM and SAX Approaches, AJAX A New Approach: Introduction to AJAX, Basics of AJAX, XML Http Request Object

Implementing programs using DOM and SAX

Unit IV: PHP Programming   **9 hours**

Introduction to PHP: Creating PHP script, Running PHP script. Working with variables and constants: Using variables, Using constants, Data types, Operators.
Controlling program flow: Conditional statements, Control statements, Arrays, functions, PHP-MYSQL Example

PHP Constructor, PHP Destructor, PHP Error Handling

Unit V: Web Frameworks   **9 hours**

Web development frameworks – Introduction to Ruby, Ruby features, Ruby operators, Ruby Data types, Ruby on rails –Design, *Web Servers*

Ruby Arrays

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Text Books

1. Robet W Sebesta ,"Programming the World Wide Web", Seventh Edition, Pearson Education,2013
2. Uttam K Roy ,"Web Technologies", Illustrated edition ,Oxford University Press, 2011
3. Sammulal Porika,"Web Technologies And Applications", First Edition, Bsp, January 2017
4. Steven Holzner ,"The Complete Reference PHP" Indian Edition, Tata McGraw-Hill,2017
5. Leonard Richardson ,"RESTful web services", 1st Edition, Ruby, O'Reilly, 2007

Reference Books

1. Kogent Learning Solutions Inc, "Web Technologies", HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, Dream Tech,2012
2. Deitel Deitel Goldberg, "Internet & World Wide Web How to Program", Third Edition, Pearson Education, 2006.
3. Bruce Tate, Curt Hibbs ,"Ruby on Rails Up and Running, Lightning fast Web development ", First Edition, Oreilly, 2006.
4. Paul Wang and Sanda Katila,"An Introduction to Web Design and Programming", First Edition,Cengage Learning,2003

Web Resources

1. https://www.javatpoint.com/php-tutorial
2. https://www.tutorialspoint.com/html/index.htm
3. https://www.geeksforgeeks.org/javascript-tutorial/
4. https://www.tutorialspoint.com/ruby/
5. https://www.w3schools.com/xml/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the protocols used by AJAX
2. List any four table tags
3. List any three types of CSS
4. Write any three advantages of XML
5. List any two advantages of java script
6. How to declare PHP variables?
7. How to create getter and setter methods in Ruby?
8. List the three control statements in PHP?

L2: Understand

1. Explain the difference between HTML,DHTML and XHTML
2. Explain about the following terms with examples (i) Unordered Lists (ii) Ordered Lists
3. Write all the basic html tags and explain with an example
4. Explain Form validation using Java script
5. Describe Arrays in Java script
6. Difference between DOM and SAX Parser
7. Explain XML Schema with an example
8. Explain conditional statements in PHP with an example

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L3: Apply

1. Design a web page using HTML, CSS and Java Script
2. Write a PHP program to print sum of digits.
3. JavaScript Program to Find the Square Root
4. Explain the creation of iterators in Ruby with examples.

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| PC | 20CS603 Modern Software Engineering | 3 | 0 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PO12	
20CS603.1	Understand the knowledge in practice of software engineering skills	3	2	2	1	L1, L2
20CS603.2	Implement software engineering models, methodologies, practices to fit the nature of software	3	2	2	1	L1, L2, L3
20CS603.3	Implement modern phases of software development with the agile process	3	2	2	1	L1, L2, L3
20CS603.4	Implement design and develop correct and robust software products	3	2	2	1	L1, L2, L3
20CS603.5	Implement right strategies in software testing, quality, risk mitigations	3	2	2	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Software Engineering   9 hours
The evolving of software - Nature of software - Software myths - Knowledge and Core Principles Software Engineering - Process framework - The capability maturity model (CMMI) process patterns - Process assessment - Personal and team process models - The waterfall model - Incremental process models - The unified process:Agility - Agile Process - Extreme Programming (XP) - The Role of tools in Agile process

Evolutionary process model

Unit II: Software Requirements Engineering and Modelling   9 hours
Functional and non-functional requirements - User requirements - System requirements - Interface specification - The software requirements document. Feasibility studies - Requirements elicitation and analysis - Requirements validation - Requirements management - Context models - Behavioral models - Data models

Identify non-functional requirements in the software's that you used frequently

Unit III: Design, The Unified Process Model, Coding   9 hours
The process in design – Quality - Design concepts - Design model - Data design - Software Architecture - Architectural Genres - Architectural styles and patterns - Architectural design - Assessing Alternative Architectural Designs - Architectural Mapping Using Data Flow - Conceptual model of UML - UML Models that Supplement the Use Case - Class diagrams - Sequence diagrams - Collaboration diagrams - Use case diagrams - Component diagrams - Structured coding Techniques- Coding Styles-Standards and Guidelines

Documentation Guidelines-Modern Programming Language Features

Unit IV: Testing and Quality Assurance   9 hours
Elements of Software Quality Assurance - SQA Tasks - Goals & Metrics - Statistical SQA - Software Reliability - A Strategic Approach to Software Testing - Strategic Issues - Test Strategies for Conventional Software - Test Strategies for Object-Oriented Software - Validation Testing - System Testing - Software Testing Fundamentals - Internal and External Views of Testing - White-Box Testing - Basis Path Testing

Test Strategies for WebApps, The Art of Debugging

Unit V: Risk Mitigation and Maintenance   9 hours
Risk management - Reactive Vs Proactive risk strategies - Software risks - Risk identification - Risk projection – Risk mitigation plan - Software Maintenance-Software Supportability- Reengineering- Business Process Reengineering- Software Reengineering- Reverse Engineering- Restructuring- Forward Engineering

Economics of Reengineering

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Text Books
1. Roger S. Pressman, "Software Engineering a practitioner's approach", Eighth edition, McGraw Hill Higher Education, 2015.
2. Rajib Mall, "Fundamentals of Software Engineering", Fifth Edition, PHI, 2018
3. Ian Sommerville, "Software Engineering", Ninth edition, 2011
4. Rajiv Chopra, "Modern Software Engineering", Wiley, 2019

Reference Books
1. PankajJalote , "Software Engineering", A Precise Approach, Wiley India, 2010.
2. Ugrasen Ivor Jacobson and Harold Bud Lawson, "The Essentials of Modern Software Engineering", ACM Books, 2019
3. Murali D., RajeswaraRao R. and Narayana V.S., "Software Engineering New Approach", BS publications, First Edition, 2018

Web Resources
1. https://en.wikipedia.org/wiki/Software_engineering
2. https://www.compact.nl/en/articles/modern-software-development/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
1. Describe two types of models available in SDLC
2. What is the need to learn Software Engineering concepts?
3. What is agile process?
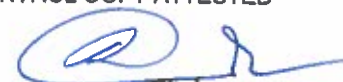4. How tools play important role in Agile Process?

L2: Understand
1. Describe key taken ways in the agile methodology
2. What is SQA role in software engineering?
3. Summarize the myths in software development
4. Demonstrate requirements eliciting

L3: Apply
1. Apply test Strategies for Object-Oriented Software
2. Illustrate Strategic approach in software testing
3. What are steps to be followed in requirement modeling of Web App?
4. Illustrate risk mitigation plan for a software development

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| PE | 20CS006 Software Quality Management | 3 | 0 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Pos	DoK
20CS006.1	Understand Software quality procedures and work instructions in software organizations.	-	L1, L2
20CS006.2	Understand about quality standards and certifications.	-	L1, L2
20CS006.3	Describe measure of software quality and how to use measurements to improve the software development process.	-	L1, L2, L3
20CS006.4	Define quality assurance plans, tasks and metrics.	-	L1, L2, L3
20CS006.5	Apply quality assurance tools & techniques.	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Software Quality   **9 hours**
What is Software Quality, Software errors, faults and failures, Classification of the causes of software errors, Definition of Software Quality, Software quality assurance – definition and objectives, Software quality assurance and software engineering, The need for comprehensive quality factors

Software Quality Challenges.

Unit II: Software Quality Assurance (SQA)   **9 hours**
Software Quality Assurance (SQA), Role of SQA, Management and its role in Software Quality Assurance, SQA unit and other actors in SQA system, Software quality model, Components of the SQA, Development and Quality Plans, SQA Process and Activities, Common SQA standards, quality tools & techniques Documentation, Reviews and Audits.

The uniqueness of software quality assurance

Unit III: Reliability and Tools   **9 hours**
Tools for Quality, Ishikawa's basic tools, CASE tools, Defect prevention and removal, Reliability models, Rayleigh model and Reliability growth models for quality assessment.

A model for SQA defect removal effectiveness

Unit IV: Quality Management System   **9 hours**
Software quality – definition, Elements of QMS, Rayleigh model framework, Reliability Growth models for QMS, Complexity metrics and models, Customer satisfaction analysis.

Software compliance with quality factors, Measurement Of Metrics.

Unit V: Quality Standards   **9 hours**
Need for standards, ISO 9000 Quality Assurance and Companion ISO Standards, CMM, CMMI, PCMM, Six Sigma concepts. Six Sigma methods: 5 Whys, Fishbone diagrams and software.

Compare ISO vs CMM vs Six sigma

Text Books

1. Allan C. Gillies, "Software Quality: Theory and Management", Third Edition, Thomson Learning, 2003
2. Daniel Galin, "Software Quality Assurance: From Theory to Implementation", First Edition, Addison Wesley, 2003
3. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", Second Edition, Pearson Education (Singapore) Pte Ltd, 2002

Reference Books

1. Dr. S. Rinesh, "Software Quality Management", First Edition, Mayas Publication, 2018

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2. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", Second edition, Addison-Wesley Professional, 2002

3. Mordechai Ben – Menachem and Garry S.Marliss, "Software Quality", Thomson Asia Pte Ltd, First Edition, 2003

Web References

1. https://www.tutorialspoint.com/software_quality_management/index.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
1. Describe any two processes related to Software Quality
2. Explain about Boehm model
3. Describe about McCall model
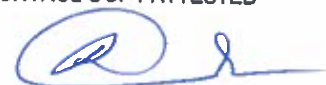4. Explain any two CMMI practices

L2: Understand
1. Classify any two different tools in Software Quality Management
2. Explain any two views of the quality
3. Explain about ISO 9000/9001 series, which serves as generic quality
4. What are the objectives of Software Quality?

L3: Apply
1. Implement the Quality Management System templates for a Software Development
2. Implement stack using arrays and linked lists
3. Discuss CMM models
4. Apply SQA plan for Software development project

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PC **20DS405 Foundations of Data Science**   3   1   0   3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO12	
20DS405.1	Illustrate the Data Science Methodology.	3	2	1	L1, L2
20DS405.2	Demonstrate different computing tools involved in data handling.	3	2	1	L1, L2
20DS405.3	Articulate clustering, decision tree concepts.	3	2	1	L1, L2, L3
20DS405.4	Demonstrate data visualization techniques.	3	2	1	L1, L2
20DS405.5	Apply domain expertise to solve real world problems using data science	3	2	1	L1, L2,L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Getting Started with Data Science   **9+3 hours**

Introduction, Analysing the Pieces of the Data Science Puzzle, Exploring the Data Science Solution Alternatives, Defining Big Data by the Three V's, Identifying Big Data Sources, Grasping the Difference between Data Science and Data Engineering, Making Sense of Data in Hadoop, Identifying Alternative Big Data Solutions, Converting Raw Data into Actionable Insights with Data Analytics, Distinguishing between Business Intelligence and Data Science, Defining Business-Centric Data Science.

Data Engineering in Action: A Case Study

Unit II: Data-Driven Insights to Business and Industry   **9+3 hours**

Benefiting from Business-Centric Data Science, Converting Raw Data into Actionable Insights with Data Analytics, Taking Action on Business Insights, Distinguishing between Business Intelligence and Data Science, Defining Business-Centric Data Science. Business Intelligence and Business-Centric Data Science.

Exploring Data Science in Business.

Unit III: Using Data Science to Extract Meaning from Your Data   **9+3 hours**

Machine Learning: Learning and its process, Learning Styles, Using Spark, Math, Probability, and Statistical Modeling: Exploring Probability, Correlation, Linear Algebra, Regression, Outliers. Using Clustering to Subdivide Data, Modeling with Instances-KNN Algorithm, Building Models That Operate Internet-of-Things Devices.

Exploring common applications of k-nearest neighbor algorithms;

Unit IV:Data Visualization   **9+3 hours**

Following the Principles of Data Visualization Design, Using D3.js for Data Visualization. Web-Based Applications for Visualization Design, Exploring Best Practices in Dashboard Design, Making Maps from Spatial Data.

Data storytelling; Querying spatial data

Unit V: Applying Domain Expertise to Solve Real-World Problems Using Data Science   **9+3 hours**

Data Science in Journalism, Delving into Environmental Data Science, Data Science for Driving Growth in E-Commerce, Using Data Science to Describe and Predict Criminal Activity.

Applying statistical modeling to natural resources in the raw; Deploying web analytics to drive growth.

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Text Books

1. Lillian Pierson, Jake Porway, "Data Science For Dummies", 2nd Edition, For Dummies, 2017

Reference Books

1. Joel Grus, "Data Science from Scratch", 2nd Edition, O'Reilly Media, 2015
2. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020.

Web References

1. https://www.simplilearn.com/tutorials/data-science-tutorial/
2. https://www.w3schools.com/datascience/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is data science? Identify three areas or domains in which data science is being used.
2. Give three examples of structured data formats.
3. Name three measures of centrality and describe how they differ.
4. What is supervised learning? Give two examples of data problems where you would use Supervised learning.

L2: Understand

1. How do data analysis and data analytics differ?
2. Relate likelihood of a model given data, and probability of data given a model. Are these two the same? Different? How?
3. How does random forest address the issue of bias or over fitting?

L3: Apply

1. If you are allocated 1 TB data to use on your phone, how many years will it take until you run out of your quota of 1 GB/month consumption? Identify the situations for pre-emption of a process
2. You are given a data set consisting of variables with more than 30 percent missing values. How will you deal with them?
3. You are given a dataset on cancer detection. You have built a classification model and achieved an accuracy of 96 percent. Why shouldn't you be happy with your model performance? What can you do about it?

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| PC | **20AI502 Machine Learning** | | | **3** | **1** | **0** | **3** |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		PO3	PO 12	DoK
		PO1	PO2			
20AI502.1	Describe the essential elements of machine learning	3	2	1	1	L1, L2
20AI502.2	Explain the learning algorithms for tree-based models and rule-based models	3	2	1	1	L1, L2
20AI502.3	Describe the algorithms for linear models and distance-based models	3	2	1	1	L1, L2
20AI502.4	Describe various probabilistic models	3	2	1	1	L1, L2
20AI502.5	Explain ensemble learning and feature engineering methods	3	2	1	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction   **9 Hours**
The ingredients of machine learning: Tasks - the problems that can be solved with machine learning – Models - the output of machine learning – Features - the workhorses of machine learning. Binary classification and related tasks: Classification, Scoring and ranking – Beyond binary classification – handling more than two classes – Unsupervised learning – Regression – Descriptive learning – Concept learning – Hypothesis space

Class probability estimation

Unit II: Tree models and Rule models   **9 Hours**
Decision trees – Random and Probability estimation trees – Tree learning as variance reduction – Rule based models: Learning ordered lists – learning unordered rule set – Descriptive rule learning

First-order rule learning

Unit III: Linear models and distance-based models   **9 Hours**
The Least Squares method – The Perceptron – Support Vector Machine – Kernel methods – Neighbours and exemplars – Nearest-neighbour classification – Distance-based clustering – Hierarchical clustering

Kernels to distances

Unit IV: Probabilistic models   **9 Hours**
Normal distribution and its geometrical interpretation – Probabilistic model for categorical data – Discriminative learning – Probabilistic model for hidden variables – Compression based models

Comparison of all models

Unit V: Features, Ensemble and Reinforcement learning   **9 Hours**
Kinds of features – Feature transformations – Feature construction and selection – Model ensembles – Bagging – Random forests – Boosting – Mapping Ensemble landscapes – bias, variance, other ensemble models – Reinforcement learning – Introduction – Q learning - Example

Meta learning

Text Books
1. Peter Flach, "Machine Learning – The art and science of algorithms that make sense of data", Cambridge Press, 2012
2. Tom Michell, "Machine Learning", McGraw Hill, 2014

Reference Books
1. Peter Harington, "Machine Learning in Action", Cengage Publications, 2012
2. MehryarMohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine LearningII, MIT Press, 2012

Web Resources
1. https://nptel.ac.in

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Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
1. Define Machine Learning.
2. List the types of Machine Learning.
3. State Bayes Theorem.
4. What is Regularization?

L2: Understand
1. Demonstrate Linear Regression.
2. Explain Back Propagation Algorithm.
3. Illustrate Decision Tree Induction process
4. Explain Genetic Operations with examples

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PE **20CS009 Network Programming and Protocols**   3   0   0   3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS009.1	Demonstrate knowledge of networking & Protocols	-	L1, L2
20CS009.2	Create sockets and Analyse different Socket types	-	L1, L2
20CS009.3	Analyze different TCP Sockets	-	L1, L2
20CS009.4	Discuss the UDP sockets , UDP client-server programs & DNS	-	L1, L2
20CS009.5	Apply the applications of sockets and demonstrate skill to design simple applications like FTP, TELNET etc.	-	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introducing Networks & Protocols   **9 hours**
OSI Layer Model, TCP/IP Layer Model, Data Encapsulation, Internet Protocol, Domain Names, Internet Routing, Port Numbers, Clients & Servers

Networks Adapters from C

Unit II: Socket APIs   **9 hours**
What are Sockets, Sockets Setup, Socket Types, Socket Functions, Anatomy of Socket Program, Berkley Sockets versus Winsock Sockets

Working with IPV6, IPV4

Unit III: Overview of TCP Sockets   **9 hours**
Multiplexing TCP Connections, Synchronous Multiplexing with select(), TCP Client, TCP Server, Blocking on send()

TCP-Stream Protocol

Unit IV: Establishing UDP Connections   **9 hours**
How UDP Sockets differ, UDP Client/Server
Host Name Resolution & DNS: How Hostname Resolution works, Name/Address translation functions, DNS Protocol

DNS Query Program

Unit V: Application Layer Protocols   **9 hours**
Building a Simple Web Client, What's in an URL, Implementing a Web Client, HTTP POST Requests

Enhanced emails

Text Books
1. Lewis Van Winkle,Hands, " Network Programming with C" , Packt Publishing Ltd, 2019
2. William Stallings, "Computer Networking With Internet Protocols and Technology", Pearson Education, 2003

Reference Books
1. Bruce Hallberg, "Networking: A Beginner's Guide", McGraw Hill, 6th Edition,2003
2. Jan Newmarch, "Network Programming with Go: Essential Skills for Using and Securing Networks", Apress; 1st ed. edition ,2017

Web Resources
1. https://tutorialspoint.dev/language/cpp/socket-programming-cc#:~:text=What%20is%20socket%20programming%3F,reaches%20out%20to%20the%20server.
2. https://www.geeksforgeeks.org/socket-programming-cc/
3. https://www.ibm.com/docs/en/zos/2.2.0?topic=interface-sample-c-socket-program

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Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	30
L2	50	70
Total (%)	100	100

L1: Remember

1. List some layers in OSI Model
2. List out OSI layers
3. Define Encapsulation
4. What is Socket programming
5. Write a short notes on HTTP

L2: Understand

1. Compare OSI Model & TCP/IP Model
2. Illustrate Internet Protocol in detail
3. Explain Internet Routing
4. Compare Berkley Sockets & Winsock Sockets
5. Explain Socket Functions in detail
6. Explain about Multiplexing TCP Connection
7. Explain TCP Clinet & Server
8. Explain Name/Address translation functions
9. Explain HTTP POST Requests

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PE   20CS010 Cloud Computing   3   0   0   3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS010.1	Identify the architecture and infrastructure of cloud computing	-	L1, L2
20CS010.2	To understand the concept of Virtualization and cloud data storage	-	L1, L2
20CS010.3	Explore the PaaS & SaaS Services.	-	L1, L2
20CS010.4	To understand the IaaS and Cloud Data Storage	-	L1, L2
20CS010.5	Develop applications for cloud computing.	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction   9 hours
Cloud computing components, Infrastructure services, Storage applications, Database services – introduction to SAAS, PAAS, IAAS, IDaaS, Data storage in cloud

Software Engineering Concepts, Cloud computing components

Unit II: Virtualization   9 hours
Enabling technologies, Types of virtualizations, Server virtualization, Desktop virtualization, Memory virtualization, Application and storage virtualization-tools and products available for virtualization

Desktop Virtualization

Unit III: SaaS & PaaS   9 hours
Getting started with SaaS, SaaS solutions, SOA, PaaS, and benefits

Public and Private clouds, Storage as a Service

Unit IV: IaaS and Cloud Data Storage   9 hours
Understanding IaaS, improving performance for load balancing, Server types within IaaS, utilizing cloud-based NAS devices, Cloud based data storage, and Backup services, Cloud based block storage and database services

Understanding IaaS

Unit V: Cloud Application Development   9 hours
Client server distributed architecture for cloud designing cloud-based solutions, coding cloud-based applications, traditional Apps vs cloud Apps, client-side programming, server-side programming overview-fundamental treatment of web application frameworks.
Inside Cloud- Introduction to MapReduce and Hadoop-overview of big data and its impact on cloud
Case Study- Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google AppEngine-Architecture and Core Concepts, Application Lifecycle, cost model. Microsoft Azure- Azure Core Concepts, SQL Azure.

Web Application Frameworks, Big Data

Text Books
1. RajkumarBuyya, James Broberg, Andrzej Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, New York, USA, 2011
2. Kris Jamsa, Jones,"Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More", Bartlett Publishers, Paperback edition,2013
3. George Reese, "Cloud Application Architectures", First Edition, O"Reilly Media 2009

Reference Books
1. RajkumarBuyya, Christian Vecchiola ,S ThamaraiSelvi," Mastering Cloud Computing".
2. RaghuramYeluri," Building the Infrastructure for Cloud Security", Published March 2014.
3. Thomas Erl," Cloud Computing: Concepts, Technology & Architecture", May 2013.
4. Srinath Perera and Thilina Gunarathne, "Hadoop Map Reduce cookbook", Packt publishing

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Web Resources

1. https://onlinecourses.nptel.ac.in/noc18_cs16/preview
2. https://www.w3schools.in/cloud-computing/cloud-computing/
3. http://freevideolectures.com/blog/2015/04/guide-to-learn-cloud-computing/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

L1: Remembering

1. Define virtual machine.
2. Define Hybrid cloud.
3. Define Big Data Cloud.
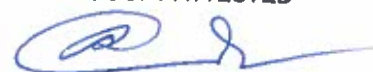4. What is service-oriented architecture?
5. Define Cloud Computing.

L2: Understanding

1. Define Cloud Computing. What are the characteristics of Cloud Computing?
2. What are the benefits of virtualization in cloud computing?
3. What are the advantages of "PAAS"? Explain with example.
4. What are pros and cons in comparison of Public Vs Hybrid cloud?
5. Describe the IBM smart cloud architecture and core Services.
6. Write a short note on importance of Quality and Security in Cloud.

L3: Applying

1. Give the entity relationship diagram for Meta CDN database and explain its architecture.
2. Write a detailed note on SaaS Integration products.
3. Briefly explain the SLA management in cloud with flow chart.
4. Explain how Cloud Computing is different from Outsourcing and Provision of Application Services.

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OE 20CEO02 Ecology, Environment and Resource Management 　　　3　0　0　3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO6	PO7	PO12	
20CEO02.1	Discuss the role that humans play in affecting the characteristics of the environment	3	3	1	L1, L2
20CEO02.2	Understand the interrelationships between land, sea, the atmosphere and the living things that occupy these environments	3	3	1	L1, L2
20CEO02.3	Distinguish between economic growth and economic development and outline the nature of a sustainable economy	3	3	1	L1, L2
20CEO02.4	Identify the environmental attributes to be considered for the EIA study	3	3	1	L1, L2
20CEO02.5	Develop a thorough understanding of Environmental Policies and legislations practiced in India	3	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2 Understand | L3 Apply | L4 Analyze | L5 Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction　　　　　　　　　　　　　　　　　　　　　　　　　　　　　9 Hours
Meaning, scope and evolution of ecology. Man, environment and ecosystem. Components of nature, Structue and Function, Flow of material, Ecological Succession, Trophic levels, Food chain, Food web, Ecological pyramids.

Adaptation, Environmental Zones

Unit II: Ecosystem and its relevance to Environment　　　　　　　　　　　　9 Hours
Resources and human settlements impact of advanced agricultural methods, Impact of urbanization and industrialization on nature. Urban ecosystem approach evolution and significance. Settlement planning.

Energy Conservation

Unit III: Resource Management and Sustainable Development　　　　　　　　9 Hours
Sustainable Development, Fundamentals concerning Environment and Sustainable Development, Economy, Poverty, Human Settlement Issues, Land Resources, Forests, Mountains, Agriculture, Biodiversity, Protection of Oceans, Industry and Business.

Planning for environmentally sensitive areas

Unit IV: Environmental Impact Assessment　　　　　　　　　　　　　　　　12 Hours
Meaning, Significance and framework. Methodologies, Checklist, Matrices, Network and social cost-benefit analysis. Sources and acquisition of environmental information. Environment impact studies of development projects.

EIA Case Studies

Unit V: Environmental Policies and Legislations in India　　　　　　　　　9 Hours
Major environment policies and legislations in India - The Ministry of Environment & Forests, The Central Pollution Control Board. Policies to protect environment in India – Environment Protection Act, 1986, National Conservation Strategy and Policy Statement on Environment and Development, 1992, Policy Statement for the abatement of Pollution, 1992, National Environment Policy, 2006, Vision Statement on Environment and Health. Legislations and Rules for the protection of Environment in India.

Five year plans in relation to environmental aspects

Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. Walter E. Westman, "Ecology, Impact Assessment and Environmental Planning", John Wiley & Sons, 1985
3. Chadwick A., "Introduction to Environmental Impact Assessment", Taylor & Francis, 2007

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Reference Books

1. Charles H. Southwick D., "Ecology and the Quality of Our Environment", Van No strand Co New York, 1976
2. Barthwal, R.R., "Environmental Impact Assessment", New Age International, New Delhi, 2002

Web References

1. http://iced.cag.gov.in/?page_id=256
2. http://econdse.org/wp-content/uploads/2016/07/chapter-1-gupta.pdf
3. https://www.researchgate.net/publication/341521590_Chapter_5_Environmental_Policy_in_India
4. https://www.preventionweb.net/files/15417_nationalenvironmentpolicyandstrateg.pdf

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

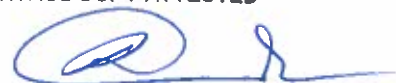### Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Ecology?
2. List any three ways in which humans directly influence environmental conditions
3. What is the goal of sustainable development?
4. List the three sequential phases of EIA
5. Enlist any four principles of National Environmental Policy of India

L2: Understand

1. Explain the key principles of the ecosystem approach to conserving natural resources
2. Explain the impact of urbanization on nature
3. How does sustainable development make economic sense for society?
4. Discuss the importance of EIA activities for developing countries
5. Discuss the objectives and founding principles of India's National Environmental Policy

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| OE | **20CSO02 Designing the Internet of Things** | **3** | **0** | **0** | **3.0** |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CSO02.1	Illustrate the IoT in different contexts	-	L1, L2
20CSO02.2	Outline the Design Principles for Connected Devices	-	L1, L2
20CSO02.3	Explain the Internet Principles & Application Layer Protocols	-	L1, L2
20CSO02.4	Apply the Prototyping concepts in IoT	-	L1, L2
20CSO02.5	Analyse the Prototyping Embedded Devices	-	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Overview of Internet of Things   **9 hours**
The flavour of the Internet of Things, The "Internet" of "Things", Technology of IoT, Enhanced Objects, Who is making the Internet of things.

Applications of IoT

Unit II: : Design Principles for Connected Devices   **9 hours**
Calm & Ambient Technology, Magic as Metaphor, Privacy: Keeping secrets, Web Thinking for Connected Devices

Examples of Connected Devices

Unit III: : Internet Principles   **9 hours**
Internet Communications-IP,TCP, The IP protocol suite(TCP/IP), UDP, IP Addresses-DNS, static IP Address assignment, Dynamic IP Address assignment, IPV6, MAC Addresses, TCP & UDP Ports, Application Layer Protocols

HTTPS: Encrypted HTTP

Unit IV: Thinking About Prototyping   **9 hours**
Sketching, Familiarity, Costs versus Ease of prototyping, Prototypes & Production, Open Source versus Closed Source

Embedded Platforms

Unit V: Prototyping Embedded Devices   **9 hours**
Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp

Aurdino Components

Textbooks
1. Adrian, McEwen & Hakim Casimally, "Designing The Internet of Things", John Wiley and Sons, 2014
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley, 2019

Reference Books
1. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms", Morgan Kaufmann,2016
2. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, "Internet Of things With Raspberry Pi And Arduino", CRC Press/Taylor & Francis Group, 2019

Web Resources

1. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
2. https://tutorialspoint.dev/computer-science/computer-network-tutorials/the-new-internet-internet-of-everything
3. https://www.javatpoint.com/iot-internet-of-things

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Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels
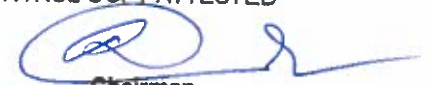
L1: Remember
1. Define IoT
2. What are the Enhanced objects for IoT?
3. What is a Prototype?
4. Define Sketching
5. Define DNS

L2: Understand
1. Explain the following terms related to Protocols: UDP, TCP
2. Discuss in detail about MAC Addresses
3. Define Prototyping? Describe the Embedded Computing Basics
4. Explain Application Layer Protocols
5. Discuss the Costs versus Ease of prototyping

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| OE | 20AIO02 Fundamentals of Deep Learning | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20AIO02.1	Describe the fundamental concept of artificial neural networks		L1, L2
20AIO02.2	Describe the function of different deep neural networks		L1, L2
20AIO02.3	Explain different deep learning algorithms	-	L1, L2
20AIO02.4	Describe the functioning of convolution and recurrent neural networks		L1, L2
20AIO02.5	Choose appropriate deep neural network for given application		L1, L2
L1: Remember	L2: Understand	L3: Apply	L4: Analyze	L5: Evaluate	L6: Create. DoK: Depth of Knowledge		

Unit 1: Introduction to Deep Learning 9 hours
Basics: Biological Neuron, Idea of computational units, McCulloch-Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

Logic gates with perceptron

Unit 2: Feedforward Networks 9 hours
Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization – Regularization, autoencoders

Applications of multilayer perceptron

Unit 3: Convolution Networks 9 hours
Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs – Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet

Applications of CNN

Unit 4: Recurrent Neural Networks 9 hours
Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks –The Long Short-Term Memory

Applications of RNN

Unit 5: Applications of Deep Neural Networks 9 hours
Applications: Large-Scale Deep Learning - Computer - Speech Recognition - Natural Language Processing

Healthcare applications

Text Books
1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, UK, 2017
2. Antonio Gulli and Sujit Pal, "Deep Learning with Keras ", Packt Publishing Ltd, Birmingham, UK, 2017

Reference Books
1. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Web References
1. https://www.coursera.org/specializations/deep-learning

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Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List any 4 benefits of artificial neural networks
2. List any 4 features of ANN
3. What are deep neural networks?
4. Define supervised and unsupervised learning
5. Define generalization

L2: Understand

1. Explain the design parameters of deep neural networks
2. Describe the dimensionality reduction techniques
3. Explain backpropagation algorithm
4. Describe any 2 applications of deep networks for image processing
5. Write about any 5 applications of deep networks

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| OE | 20DSO02 Introduction to Data Science | 3 | 0 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20DSO02.1	Understand Fundamentals of Data Science Terminology.		L1, L2
20DSO02.2	Demonstrate different computing tools involved in data handling.		L1, L2
20DSO02.3	Understand Knime Tool.	-	L1, L2
20DSO02.4	Understand Machine Learning Concepts		L1, L2
20DSO02.5	Apply domain expertise to solve real world problems using data science		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Data Science   **9 Hours**
Analysing the Pieces of the Data Science Puzzle, Exploring the Data Science Solution Alternatives, Defining Big Data by the Three Vs, Grasping the Difference between Data Science and Data Engineering, Making Sense of Data in Hadoop, Identifying Alternative Big Data Solutions, Converting Raw Data into Actionable Insights with Data Analytics, Distinguishing between Business Intelligence and Data Science, Defining Business-Centric Data Science

Identifying Data Science Users; Data Engineering in Action: A Case Study

Unit II: Computing for Data Science - 1   **9 Hours**
Using Python for Data Science, Using Open Source R for Data Science.

Sorting Out the Python Data Types; R's Basic Vocabulary

Unit III: Computing for Data Science - 2   **9 Hours**
Using SQL in Data Science, Doing Data Science with Excel and Knime

Basic SQL Commands; Knime Basics

Unit IV Machine Learning, Probability and Statistical Modelling   **9 Hours**
Defining Machine Learning and Its Processes, Considering Learning Styles, Seeing What You Can Do, Exploring Probability and Inferential Statistic, Quantifying Correlation, Reducing Data Dimensionality with Linear Algebra, Modeling Decisions with Multi-Criteria Decision Making, Introducing Regression Methods

Linear Regression

Unit V Applying Domain Expertise to Solve Real-World Problems Using Data Science   **9 Hours**
Data Science in Journalism,Delving into Environmental Data Science, Data Science for Driving Growth in E-Commerce, Using Data Science to Describe and Predict Criminal Activity

Applying statistical modeling to natural resources in the raw; Deploying web analytics to drive growthh

Text Books
1. Lillian Pierson and Jake Porway,"Data Science For Dummies", 2ⁿᵈ Edition,For Dummies, 2017

Reference Books
1. Joel Grus, "Data Science from Scratch", 2ⁿᵈ Edition, O'Reilly Media, 2015
2. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020

Web Resources
1. https://www.simplilearn.com/tutorials/data-science-tutorial/
2. https://www.w3schools.com/datascience/

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Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is data science? Identify three areas or domains in which data science is being used
2. Give three examples of structured data formats
3. Name three measures of centrality and describe how they differ
4. What is supervised learning? Give two examples of data problems where you would use Supervised learning

L2: Understand

1. How do data analysis and data analytics differ?
2. Relate likelihood of a model given data, and probability of data given a model. Are these two the same? Different? How?

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OE 20ECO02 IoT for Smart Grids

3	0	0	3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20ECO02.1	Demonstrate the Smart Grid concept ,Need for smart grid		L1, L2
20ECO02.2	Explain the Energy Management System functions		L1, L2, L3
20ECO02.3	Describe how modern power distribution system functions		L1, L2
20ECO02.4	Explain the Advanced metering infrastructure and AMI protocols		L1, L2, L3
20ECO02.5	Identify suitable communication networks for Smart Grid applications		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Smart Grid   **12 Hours**
Introduction - Evolution of Electric Grid, Smart Grid Concept - Definitions and Need for Smart Grid – Functions – Opportunities – Benefits and challenges, Difference between conventional & Smart Grid.

Technology Drivers

Unit II: Energy Management System   **12 Hours**
Energy Management System (EMS) - Smart substations - Substation Automation – Feeder Automation, SCADA – Remote Terminal Unit – Intelligent Electronic Devices – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources.

Energy Storage

Unit III: Distribution Management System   **12 Hours**
Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Outage management System, Customer Information System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles.

Network Reconfiguration

Unit IV: Smart Meters   **12 Hours**
Introduction to Smart Meters – Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing.

Peak Time Pricing

Unit V: Communication Networks & IoT   **12 Hours**
Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) – Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing.

Cyber Security for Smart Grid

Textbooks

1. Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", CRC Press, 2012
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu and Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley, 2012

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Reference Books

1. Mini S. Thomas and John D McDonald, "Power System SCADA and Smart Grids", CRC Press, 2015
2. Kenneth C. Budka, Jayant G. Deshpande and Marina Thottan, "Communication Networks for Smart Grids", Springer, 2014

Web Resources

1. https://books.google.co.in/books?isbn=1119969093
2. https://books.google.co.in/books?isbn=135123093X

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define a Smart grid
2. List any three Benefits of Smart grid
3. What is SCADA?
4. List any three Intelligent Electronic Devices
5. Define a Fault Detection

L2: Understand

1. Explain the need of Smart Grid
2. Demonstrate the Smart Grid Concept
3. Explain the Energy Management System (EMS)
4. Classify and explain the Smart integration of energy resources
5. Illustrate Effect of Plug in Hybrid Electric Vehicles

L3: Apply

1. Identify the Outage management System
2. How to utilize the Distribution Management System (DMS)? explain

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| OE | 20EEO02 Electrical Safety and Management | 3 | 0 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EEO02.1	Understand the Indian electricity rules and their significance		L1, L2
20EEO02.2	Explain the safety standard in residential, commercial, and agricultural		L1, L2
20EEO02.3	Learn about electrical safety installation, testing and commission		L1, L2
20EEO02.4	Understand about electrical safety in distribution system		L1, L2
20EEO02.5	Explain flash-overs and corona discharge		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Indian Electricity Regulations and Acts and their Significance   12 Hours
Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage – earthing of system neutral – Rules regarding first aid and fire fighting facility.

The Electricity Act2003 (Part 1,2,3,4 & 5) and Control Authority Safety Regulations

Unit II: Electrical Safety in Residential, Commercial and Agriculture Installations   12 Hours
Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

System grounding and Equipment grounding

Unit III: Safety During Installation, Testing and Commissioning, Operation and Maintenance   12 Hours
Preliminary preparations – safe sequence – risk of plant and equipment –safety documentation – field quality and safety - personal protective equipment – safety clearance notice – safety precautions – safeguards for operators – safety

Magnetic Hot sticks, protective clothing and industrial clothing

Unit IV: Electrical Safety in Hazardous Areas   12 Hours
Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours.

Hazards associated with currents and voltages

Unit V: Electrical Safety Shocks and their Prevention   12 Hours
Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

Objectives of Safety and Security Measures

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Text Books

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy Management Policy, Planning and Utilization", Concept Publishing Company, 1997
3. John M Madden, "Electrical Safety and Law, Planning and Utilization", 5th Edition, Routledge, 2017

Reference Books

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
2. Martha J Boss and Gayle Nicoll, "Electrical Safety", 1st Edition, CRC Press, 2014
3. Gupta, B.R., "Electrical Safety", 1st Edition, American Technical Publishers, 2018

Web References

1. https://nptel.ac.in/courses/108/104/108104087/
2. https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/
3. https://www.edx.org/course/electricity-and-magnetism-maxwells-equations

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	40
L2	70	60
Total (%)	100	100

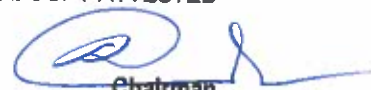## Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Give the classification of electrical installations.
2. State the disadvantages of low power factor.
3. What is safety documentation system?
4. State preliminary preparations before commencing the installation.

L2: Understand

1. Write the objectives and scope of Indian Electricity Act and Indian Electricity Rule.
2. Explain the importance of earthing system neutral.
3. Write a note on Do's and Don't for safety in the use of domestic electrical appliances.
4. Explain the classification of equipment/enclosure for hazardous locations.

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| OE | **20MEO02 Fundamentals of Automobile Engineering** | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes	DoK
20ME302.1	Introduction to fundamentals of automobiles, lubrication, Tires and safety.	L1, L2
20ME302.2	Classify and identify the steering system	L2, L3
20ME302.3	Classify and identify the Transmission system	L2, L3
20ME302.4	Define and compare the suspension, breaking and electrical system.	L2,L4
20ME302.5	Identify and Interpret the specifications and safety precautions..	L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction
11+1 Hours

Componentsoffourwheelerautomobile–chassisandbody–powerunit–typesofautomobileengines,engineconstruction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps–crank case ventilation–. Types – wheels and tyres. Safety Introduction, safety systems-seat belt, airbags, bumper, anti lock brake system (ABS), windshield, suspension sensors, traction control, mirrors, central locking and electric.

windows, speed control.

Unit II: TRANSMISSION SYSTEM
11+1 Hours

Power transmission–rear wheel drive, front wheeldrive,4wheeldrive Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchromesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotch – Kiss drive.

Torque tube drive, universal joint, differential rear axles.

Unit III: STEERING SYSTEM
11+1 Hours

Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism ,steering gears, –types
Steering linkages.

Unit IV: SUSPENSION, BREAKING AND ELECTRICAL SYSTEM
11+1 Hours

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system. BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylindertandemmaster cylinder requirement of brake fluid
ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendixdrivemechanismsolenoidswitch,lightingsystems,horn,wiper,fuelgauge–oilpressuregauge,enginetemperatureindicatoretc.

Pneumatic and vacuum brakes.

Unit V: ENGINESPECIFICATION AND MAINTENANCE
11+1 Hours

Introduction-engine specifications with regard to power, speed, torque, no.of cylinders and arrangement, lubrication and cooling etc. engine service, reboring, decarburization ,Nitriding of crankshaft. service details of engine cylinder head, valves and valve mechanism, piston-connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly-precautions. Types of pollutants, mechanism of formation, concentration measurement, methods of controlling-enginemodification,exhaustgastreatment-thermalandcatalyticconverters-useof alternative fuels for emission control

National and International pollution standards .

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Text Books
1. Automotive Mechanics–Vol.1&Vol.2/KirpalSingh/standardpublishers
2. Automobile Engineering/WilliamCrouse/TMHDistributors
3. Automobile Engineering/P.SGill/S.K.Kataria&Sons/NewDelhi.
4. Automobile Engineering/CSrinivasan/McGrawHill

Reference Books
1. AutomotiveEnginesTheoryandServicing/JamesD.HaldermanandChaseD.MitchellJr.,/Pearso neducationinc.
2. AutomotiveEngineering/KNewton,W.Steeds&TKGarrett/SAE
3. AutomotiveMechanics: PrinciplesandPractices/ JosephHeitner/VanNostrandReinhold

Web References
1. https://nptel.ac.in/noc

Internal Assessment Pattern

Cognitive Level	Internal Assessment#1(%)	Internal Assessment#2(%)
L2	40	30
L3	40	30
L4	20	40
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels
L1: Remember
1. What are the differences between two and four stroke engines.
2. Define the Octane number & Cetane number
3. Explain the significance of governor in automobiles?
4. What is an automotive differential and how does it work?
5. Why are car steering wheels round?
6. Why entropy decreases with the increase in temperature?

L2: Understand
1. Describe the Atkinson cycle..
2. Explain the flywheel with neat sketch.
3. What is an injector pressure in heavy vehicles? Why it is used?
4. Discuss the service the piston – connecting rod assembly with neat sketch.
5. Discuss the magneto ignition.
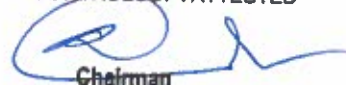6. What is 3-way converter?

L3: Classify
1. .Name the different cooling methods with neat sketches.
2. Describe with P-V diagrams the two used cycles for internal combustion engines.

L4: Interpret
1. In a 4-stroke, 4-stroke cylinder diesel engine running 5000 r.p.m., how many times the fuel will be injected per second.
2. Name the car with engine having 4-valves and 5- valves per cylinder.gas at a pressure of1.5Mpa,the gas expands according to the process Which represented by a straight line on a pressure volume. The final pressure is 0.15MPa. Calculate the work done on a gas by the piston

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| PC | 20CS606 Cryptography and Network Security Lab | 0 | 0 | 3 | 1.5 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO4
20CS606.1	Implement classical encryption techniques to solve the problems.	3
20CS606.2	Implement encryption algorithms	3
20CS606.3	Implement authentication algorithms	3
20CS606.4	Implement symmetric and asymmetric key algorithms for cryptography	3
20CS606.5	Implement firewall design principles and identify various intrusion detection systems and be able to achieve highest system security	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

List of Experiments

1. Perform encryption, decryption using the following substitution techniques
   i) Ceaser cipher
   ii) Playfair cipher
   iii) Hill Cipher
   iv) Vigenere cipher
2. Perform encryption and decryption usingfollowing transposition techniques
   i) Rail fence
   ii) Row & Column Transformation
3. Apply DES algorithm for practical applications.
4. Apply AES algorithm for practical applications.
5. Implement RSA Algorithm using HTML and JavaScript
6. Implement the Diffie-Hellman Key Exchange algorithm for a given problem.
7. Calculate the message digest of a text using the SHA-1 algorithm.
8. Implement the SIGNATURE SCHEME - Digital Signature Standard.
9. Demonstrate intrusion detection system (ids) using any tool eg. Snort or any other software.
10. Automated Attack and Penetration Tools Exploring N-Stalker, a Vulnerability Assessment Tool
11. Defeating Malware
    i) Building Trojans
    ii) Rootkit Hunter

Reference

1. Lab Manual for Cryptography and Network Security Lab, Department of Computer Science and Engineering, NSRIT

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PC	20CS607 Web Technologies Lab	0	0	3	1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO4
20CS607.1	Create and apply the role of languages like HTML, CSS	3
20CS607.2	Build dynamic web pages using JavaScript	3
20CS607.3	Create and apply the role of language like XML	3
20CS607.4	Develop Web Applications using PHP & MySql	3
20CS607.5	Install & Use Frameworks	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

List of Experiments

1. Design the static web pages required for an online book store web site.
   1) HOME PAGE: The static home page must contain three frames.
   2) LOGIN PAGE
   3) CATOLOGUE PAGE: The catalogue page should contain the details of all the books available in the web site in a table.
   4) REGISTRATION PAGE
2. Develop and demonstrate the usage of inline, internal and external style sheet using CSS
3. Design a web page using CSS (Cascading Style Sheets) which includes the following: 1) Use different font, styles: In the style definition you define how each selector should work (font, color etc.). Then, in the body of your pages, you refer to these selectors to activate the styles
4. Write a Java Script program by using variables
5. Write a java script program to multiply two numbers and display the result in separate text box
6. Write JavaScript to validate the following fields of the Registration page.
   1. First Name (Name should contains alphabets and the length should not be less than 6 characters).
   2. Password (Password should not be less than 6 characters length).
   3. E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com)
   4. Mobile Number (Phone number should contain 10 digits only).
   5. Last Name and Address (should not be Empty)
7. Design an HTML having a text box and four buttons viz Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate javascript function should be called to display
   a. Factorial of that number b. Fibonacci series up to that number c. Prime numbers up to that number d. Is it palindrome or not
8. Create an XML document that contains 10 users information. Write a Java Program, which takes User Id as input and returns the user details by taking the user information from XML document using DOM parser or SAX parser.
9. Develop and demonstrate PHP Script for the following problems:
   a) Write a PHP Script to find out the Sum of the Individual Digits.
   b) Write a PHP Script to check whether the given number is Palindrome or not
10. Write a PHP to connect to the database, Insert the details of the student academic information with student academic info page.
11. Implement the web applications with Database using PHP

Reference

1. Lab Manual for Web Technologies ,Department of Computer Science and Engineering, NSRIT

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| PC | 20CS608 Modern Software Engineering Lab | 0 | 0 | 3 | 1.5 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Pos PO4
20CS608.1	Implement software engineering methodologies involved in the phases for project development.	3
20CS608.2	Develop a model Software Requirement Specification document for proposed system	3
20CS608.3	Implement high-level design of the system from the software requirements using knowledge of software design process	3
20CS608.4	Implement software models to cater business scenarios	3
20CS608.5	Implement test cases for various white box and black box testing techniques	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

List of Experiments

Implement the following exercises for any two projects below:

1. Development of problem statement from the user stories
2. Preparation of Software Requirements Document and convert in to use cases
3. Do requirement analysis and develop Software Requirement Specification document for proposed system.
4. Development of Entity Relationship(E-R) diagram
5. Design high-level design of the system
6. Draw Use case and Class diagrams
7. Draw Sequence and Activity diagrams
8. Develop the prototype of the product
9. Write unit and function test cases for the requirements

Sample Projects:

1. Online Exam Registration
2. E-book management System.
3. Recruitment system
4. Banking System
5. Airline Reservation System
6. Library Management System

Reference

1. Lab Manual for Modern Software Engineering Department of Computer Science and Engineering, NSRIT
2. Software Engineering- Sommerville, Pearson Education, 7th edition.
3. The unified modelling language user guide Grady Booch, James Rambaugh, Ivar Jacobson, Pearson Education.

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SC 20CSS04 Android App Development

0 0 4 2.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs and PSOs			DoK
		PO5	PSO1	PSO2	
20CSS04.1	To illustrate the different components of Android OS in detail	3	3	3	L1, L2
20CSS04.2	To develop a mobile application using different components of Android	3	3	3	L1, L2
20CSS04.3	To choose appropriate controls to design the GUI to meet desired needs	3	3	3	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Android SDK Features, The Dalvik Virtual Machine, Downloading and Installing the Android SDK, Developing with Eclipse, Application Manifest File, Creating resources, Drawables, Layouts, Animations, Menus, Building user Interfaces-Assigning user interfaces to Activities, Layouts-Linear, Relative and Grid Layout, Working with fragments, Android widget Toolbox-Creating New Views, Introducing adapters, Intents and Broadcast receivers, Databases and content providers-SQLite Databases and content Providers, Introducing services, Using background threads, using alarms, Customizing toasts, Introducing Notifications, Maps

References

1. Reto Meier, "Professional Android 4 Application Development", Wrox,2018
2. Dave MacLean, Satya Komatineni, Grant Allen, "Pro Android 5", Apress 2015
3. John Horton, "Android Programming for Beginners", PACKT 2015
4. Wallace Jackson, "Android Apps for Absolute Beginners", Apress, 2013

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MC 20MCX04 Indian Traditional Knowledge   2   0   0   0.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO6	PO7	PO12	
20MCX04.1	Identify the concept of Traditional knowledge and its importance	1	3	3	2	L1, L2
20MCX04.2	Explain the need and importance of protecting traditional knowledge	1	2	3	2	L1, L2
20MCX04.3	Illustrate the various enactments related to the protection of traditional knowledge	1	3	3	2	L1, L2
20MCX04.4	Interpret the concepts of Intellectual property to protect the traditional knowledge	1	2	3	2	L1, L2
20MCX04.5	Explain the importance of Traditional knowledge in Agriculture and Medicine	1	3	3	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create

UNIT-I: Introduction to traditional knowledge   4 hours

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT-II: Protection of traditional knowledge   4 hours

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT-III: Legal framework and TK: 4 hours

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT-IV: Traditional knowledge and intellectual property: 4 hours

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT-V Traditional Knowledge in Different Sectors: 4 hours

Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

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Text Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
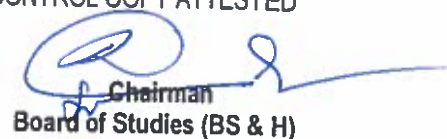
Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

Web Links:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

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PE 20CS011 Software Testing Methodologies   3   0   0   3

Pre- Requisite   Software Engineering

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS011.1	Demonstrate the evaluation of Software Testing and its life cycle		L1, L2
20CS011.2	Understand Black Box and White Box Testing Techniques		L1, L2
20CS011.3	Analyze the necessary software techniques and activities to be planned	-	L1, L2, L3
20CS011.4	Analyze contemporary issues in software testing and design best test strategies.		L1, L2, L3
20CS011.5	Apply tools to implement automation testing		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Software Testing   9 Hours
Introduction, How Software Testing Evolved, Myths & Facts, Goals, Psychology, Model for testing, Effective Vs Exhaustive Software Testing, Software Testing Terminology and Methodology, Software Testing Life Cycle, Verification and Validation: Activities, Requirements, High level and low-level designs, Verifying code, Validation.

Exhaustive Software Testing

Unit II: Black Box and White Box Testing   9 Hours
Black Box Testing Techniques: Boundary Value Analysis, Equivalence class Testing, State Table Based Testing, Decision Table Based Testing, Cause-Effect Graphing Based Testing, Error Guessing. White-Box Testing: Need, Logic Coverage Criteria, Basis Path Testing, Graph Matrices, Loop Testing, Data Flow Tests, Mutation Testing.

State Table Based Testing

Unit III: Validation Activities, Static and Regression Testing   9 Hours
Validation Activities, Unit testing, Integration Testing, Function Tests, System Testing, Acceptance Testing, Static Testing, Inspections, Structured Walkthroughs, Technical Reviews. Regression Testing: Progressives Vs Regressive Testing, Regression Test Ability, Objectives of Regression Testing, Regression Testing Types and Regression Testing Techniques.

Objectives of Regression

Unit IV: Test Suite Management   9 Hours
Growing nature of test suite, Minimizing the test suite and its benefits, Test suite prioritization, Types of test case prioritization, Prioritization techniques, Measuring the effectiveness of a prioritized test suite. Software Quality Management: Software Quality metrics, SQA models. Debugging: Process, Techniques and Correcting bugs.

Software Quality Management

Unit V: Test Automation   9 Hours
Need of Test Automation, Categorization of Testing Tools, Selection of Testing Tools, Cost Incurred, Guidelines for Automated Testing, Overview of some commercial testing tools such as Win Runner, Load Runner, Jmeter and Junit, Test Automation using Selenium Tool, Testing Object Oriented Software: Basics, Object oriented Testing, Testing Web based Systems: Challenges in Testing for Web Based Software, Quality Aspects, Web Engineering, Testing of Web Based Systems, Testing Mobile Systems.

Test Automation

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Text Books

1. Naresh Chauhan, "Software Testing, Principles and Practices", 2nd Edition, Oxford, 2016
2. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing Principles and Practices", 1st Edition, Kindle, 2005
3. Paul C Jorgensen. "Software Testing: A Craftsman's Approach", Fourth Edition, CRC Press, 2013

Reference Books

1. M G Limaye, "Software Testing Principles and Techniques and Tools," Tata Mc Graw – Hill Education, 1st Edition, 2012.
2. Dr. K. V. K. K.Prasad, "Software Testing Tools," Dreamtech, 1st Edition, 2004.
3. William E. Perry, "Effective Methods for Software Testing," Wiley, 3rd Edition, 2006

Web References

1. https://www.geeksforgeeks.org/software-testing-basics
2. https://www.javatpoint.com/software-testing-tutorial
3. https://www.guru99.com/software-testing-introduction-importance.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Describe about software testing evaluation?
2. What are myths and facts of Software Testing?
3. Explain about Testing Life cycle?
4. List the guidelines for test automation?

L2: Understand

1. Classify Software Testing methods.
2. Explain about Win runner and Load Runner
3. Differentiate functional and regression testing
4. Explain about object oriented software testing

L3: Apply

1. Analyze the challenges in testing for web-based software?
2. Evaluate Win Runner and Load Runner?
3. Apply Junit frame work for Software Testing?
4. Evaluate Jmeter in Software Performance Testing?

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PC 20DS502 Big Data   3   0   0   3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO2	
20DS502.1	Able to understand the building blocks of Big Data	3	1	L1, L2
20DS502.2	Articulate the programming aspects of cloud computing (map Reduce etc)	3	1	L1, L2,L3
20DS502.3	Understand the specialized aspects of big data with the help of different big data applications	3	1	L1, L2
20DS502.4	Able to understand the concepts of Spark	3	1	L1, L2, L3
20DS502.5	Able to understand the concept of Hive	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit-I   9+3 Hours
Working with Big Data:
What is Big Data, The core technologies of Hadoop. Google File System, How to develop MapReduce jobs. Hadoop Distributed File System (HDFS) – Building blocks of Hadoop, Namenode, Datanode, Secondary Namenode, JobTracker, Task Tracker.

HDFC File System

Unit-II: 9+3 Hours
Configuring Hadoop cluster:
Hadoop's History, Core Hadoop Concepts, Hadoop Clusters, Installation and Configuration, Local, Pseudo-distributed mode, Fully Distributed mode, Configuring XML files.

XML Files configuration

Unit-III: 9+3 Hours
Introduction to Spark :
Introduction to spark, introduction to RDD, Fundamental role of Data Frames, data frames in different perspectives, graphical representation of data frames, essential role of data frames in Spark, CSV files.

CSV Files

Unit-IV: 9+3 Hours
RDD Basics, RDD Operations, RDD lineage graphs, Transformations on Pair RDDs, Actions Available on Pair RDDs, Advanced Spark Programming, Introduction, Accumulators, Accumulators and Fault Tolerance, Custom Accumulators, Piping to External Programs, Spark Runtime Architecture. Structured Data with Spark SQL.

Data Frames

Unit- V: 9+3 Hours
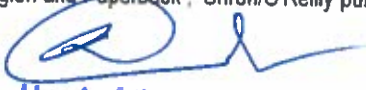**Introduction to Hive:**
An introduction to Hive, Architecture & Modes, Download & Install HIVE on Ubuntu, Hive Data Types, Creation of tables & Drop Database in Hive, Hive Partitions & Buckets, Hive Indexes and View, Hive Queries, Hive ETL — Loading JSON, XML, Text Data Examples.

HIVE Queries

Text Books:
1. Chuck Lam,,"Hadoop in Action" 1 Addition,2016 , MANNING Publ.
2. Holden Karau, Andy Konwinski , Patrick Wendell and Matei Zaharia, "Learning Spark",OREILLY Publications, 1st Edition ,February 2015.
3. "Spark in Action", ROB THOMAS, Manning Publications,2nd Edition, 1st Addition ,February 2018.
4. "Programming Hive: Data Warehouse And Query Language For Hadoop"
5. Edward Capriolo,Dean Wampler,Jason Rutherglen and Paperback , Shroff/O'Reilly publisher,1st addition, year 2012.

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References:

1. Alex Holmes ," Hadoop IN Practice" , 2nd addition , 2015, Mannin Publications.
2. "Spark in Action",ROB THOMAS,Manning Publications,2nd Edition, 2020.
3. Big Java 4th Edition, Cay Horstmann, Wiley John Wiley & Sons, INC

Web Refrences:

1. https://www.manning.com/books/spark-in-action-second-edition
2. Hadoop:http://hadoop.apache.org/
3. Hive: https://cwiki.apache.org/confluence/display/Hive/Home

Internal Assessment Pattern

Cognitive Level	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	30	30
L2	30	40
L3	40	30
Total(%)	100	100

L1: Remember

1. Explain Write Types of keys and mapper, reducer, combiner (if any) and which of the types need to Writable.
2. Explain features of spark
3. What do the features of Spark provide, which is not available to the Map-Reduce?
4. What happens when a Spark Job is submitted?
5. What are different Hive Data Types. And how to Managing Databases and Tables in hive?

L2: Remember

6. How spark core fit into the picture to solving the big data use case?
7. Explain the operations performed on stacks and queues with examples.
8. How to create a table by using HIVE.
9. What are the benefits of using Spark streaming for real time processing instead of other framework and tools?
10. Why we need the master driver in spark?

L3: Apply

1. What Spark-SQL does, how it's benefits to programmer to interact with database?
2. What is the Syntax of creating SQL Context?
3. What are the key component of spark which internally spark require to execute the job?.
4. What is RDD?
5. How does spark RDD works? What are the various ways to create the RDD?
6. Elaborate the other notable feature of RDD and ways to create the RDD?

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| **PC** | **20AI602 Deep Learning Principles and Practices** | **3** | **1** | **0** | **3.0** |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | DoK |
		PO2	PO3	PO5	PO12	
20AI602.1	Understand the basic concepts of deep learning	3	2	2	1	L1
20AI602.2	Illustrate different deep learning models	3	2	2	1	L1, L2
20AI602.3	Explain dimension reduction techniques	3	2	2	1	L1, L2
20AI602.4	Describe the optimization in deep learning networks	3	2	2	1	L1, L2
20AI602.5	Analyse the deep learning applications	3	2	2	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction
9 +3 hours

Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

Terminologies of machine learning

Unit II: Deep Networks
9 + 3 hours

History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization - Batch normalization- VC Nets-Deep Vs Shallow Networks - Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning

Design parameters of deep networks

Unit III: Dimensionality Reduction
9+3 hours

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization

Need for dimension reduction

Unit IV: Optimization and Generalization
9+3 hours

Optimization in deep learning– non-convex optimization for deep networks- Stochastic Optimization - Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning

Computational Artificial Neuroscience

Unit V: Case Study and Applications
9+3 hours

Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection - BioInformatics- Face Recognition- Scene Understanding- Gathering Image Captions

Face detection

Text Books
1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, UK, 2017
2. Antonio Gulli and Sujit Pal, "Deep Learning with Keras ", Packt Publishing Ltd, Birmingham, UK, 2017

Reference Books
1. Cosma Rohilla Shalizi, "Advanced Data Analysis", Elementary Point of View, 2015.
2. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
3. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

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Web References

1. https://www.coursera.org/specializations/deep-learning

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels
L1: Remember

1. List any four benefits of artificial neural networks
2. List any four features of ANN
3. What are deep neural networks?
4. Define supervised and unsupervised learning
5. Define generalization

L2: Understand

1. Explain the design parameters of deep neural networks
2. Describe the dimensionality reduction techniques
3. Explain backpropagation algorithm
4. Describe any two applications of deep networks for image processing
5. Write about any five applications of deep networks

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| PE | 20CS014 Block Chain Technologies | 3 | 0 | 0 | 3 |

Pre- Requisite   Cryptography, Data Structures, Web Development

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS014.1	Understand the fundamentals of Blockchain		L1, L2
20CS014.2	Compare Bitcoin with other alternative coins.		L1, L2
20CS014.3	Analyze Ethereum model	-	L1, L2
20CS014.4	Understand and use Hyperledger and its development framework.		L1, L2
20CS014.5	Understand emerging trends in Blockchain		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Block Chain   9 Hours
History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization

Block Chain Security Issues

Unit II: Introduction to Cryptocurrency   9 Hours
Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts

Cryptocurrency Failures

Unit III: Ethereum   9 Hours
The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language

Ethereum Development Environment, Smart Contract on Blockchain

Unit IV: Web3 and Hyperledger   9 Hours
Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda

Business Network on Hyperledger

Unit V: Alternative Block Chains and Next Alternative Trends   9 Hours
Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

Blockchain Framework and Business Applications

Text Books

1.   Imran Bashir,"Mastering Blockchain:Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018

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Reference Books

1. ArshdeepBahga, Vijay Madisetti, "Blockchain Applications: A Hands On Approach", Thirs EditionVPT, 2017
2. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", Second Edition,O'Reilly, 2014
3. Roger Wattenhofer, "The Science of the Blockchain" CreateSpace Independent Publishing, Second Edition,2016.
4. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016

Web References

1. https://nptel.ac.in/courses/106/104/106104220/#
2. https://www.udemy.com/course/build-your-blockchain-az/
3. https://eduxlabs.com/courses/blockchain-technologytraining/?tab=tab-curriculum

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is the difference between Blockchain and Hyperledger?
2. What do you mean by blocks in blockchain technology?
3. What is Cryptography role in blockchain?

L2: Understand

1. Explain different type of Blockchain
2. How is hash generated
3. What is smart Contract and list some of its applications

L3: Apply

1. Create simple blockchain in any suitable programming language
2. Create case study of blockchain being used in illegal activities in real world
3. Write a crowd-sale smart contract in any suitable programming language

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PE 20CS015 XML and Web Services   3   0   0   3

Pre- Requisites Computer Networking, Web Technologies

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS015.1	Demonstrate through XML and Web Services		L1, L2, L3
20CS015.2	Understand Web Service Architecture & Explore through Soap and Rest Web Services		L1, L2, L3
20CS015.3	Demonstrate Web services architecture and it advantages.	-	L1, L2, L3
20CS015.4	Able to Create Soap service using JAX-WS and Rest service using JAX – RS		L1, L2, L3
20CS015.5	Apply JAX-RPC, JAX-WS and JAX-RS to implement web services		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to XML   9 Hours
Introduction to XML, DTD VS XSD, XML Parsing, XML Binding API's: JAX-P API based XML parsing using (SAX, DOM), Validating XML Documents using JAX-VP, XML Binding using JAX-B (Marshalling, Un-Marshalling and In-Memory Validation)

JAX-VP

Unit II: Introduction to Web Services   9 Hours
Web Service Architecture, Web Services vs Other Technologies, Web Services Benefits.

Web Services Benefits

Unit III: JAX – RPC and WSDL   9 Hours
JAX-RPC API, Building Web service Using JAX-RPC API and Request processing in JAX-RPC.Purpose of WSDL, Message Exchange Patterns and Formats, Elements of a WSDL Document and Writing a WSDL Document

Elements of WSDL Document

Unit IV: SOAP and JAX-Ws   9 Hours
Purpose of SOAP, Elements of SOAP, About JAX-WS, JAX-WS Vs JAX-RPC, Building Web Service using JAX – WS

JAX-WS vs JAX-RPC

Unit V: Restful Service and JAX – RS   9 Hours
What is Rest Service, Web Services VS Web Resource and Building Web Resource using JAX – RS.

Rest Service

Text Books

1. Frank P.Coyle, "XML, Web Services and the Data Revolution." First Edition, Addison-Wesley,2 002.
2. Ron Schmelzer, Travis Vandersypen, Travis Vandersypen, Jason Bloomberg, "XML and Web Services Unleashed", Second Edition, Sams, 2002

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Reference Books

1. Robert J. Brunner, Frank Cohen, Francisco Curbera, Darren Govoni, Matthias Kloppmann, Steven Haines. "Java Web Services", 1st Edition, Unleashed, Sams Publishing, 2002
2. Eric Newcomer, "Understanding Web Services: XML, WSDL, SOAP and UDDI", 1st Edition, Impendent Technology Guides, 2002
3. Thomas Erl, "Service-Oriented Architecture: A Field Guide to Integrating XML and Web Services" 2nd Edition, Prentice Hall, 2004

Web References

1. https://www.w3schools.com › xml › xml_services.asp
2. https://www.tutorialspoint.com › webservices › what_are_web_services.htm
3. https://www.javatpoint.com › what-is-web-service

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Describe Web Service?
2. Name some types of Web services?
3. Tell about a WSDL?
4. List some applications of Web Services?

L2: Understand

1. Classify Web services.
2. Explain about JAX-RPC Web Service
3. Differentiate JAX-RPC vs JAX-WS Vs JAX-RS
4. Explain about different sorting algorithms

L3: Apply

1. Implement the JAX-RPC Web Service
2. Evaluate Web Service using JAX-RPC
3. Apply JAX-WS for developing Web Service.
4. Apply JAX-RS for developing Web Service.

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| PE | 20CS016 Software Project Management | 3 | 0 | 0 | 3 |

Pre- Requisites Problem Solving, Time Complexity, Software Engineering

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS016.1	Describe the organizational needs to the most effective software development model		L1, L2
20CS016.2	Apply the concepts of project management & planning		L1, L2,L3
20CS016.3	Implement the project plans through managing people, communications and change		L1, L2,L3
20CS016.4	Describe activities necessary to successfully complete and close the Software projects	-	L1, L2
20CS016.5	Implement communication, modelling, and construction & deployment practices in software development		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Conventional Software Management   9 Hours
The Waterfall Model, Conventional Software Management Performance, Evolution of Software Economics: Software Economics, Pragmatic Software Cost Estimation

Objectives and Goals

Unit II: Improving Software Economics   9 Hours
Reducing Software Product Size, Improving Software Processes, Improving Team Effectiveness, Improving Automation, Achieving Required Quality, Peer Inspections, The old way and the new- The Principles of Conventional Software Engineering. Principles of Modem Software Management, Transitioning to an Iterative Process

Process Workflows

Unit III: Life Cycle Phases   9 Hours
Engineering and Production Stages, Inception, Elaboration, Construction, Transition Phases, Artefacts of the Process: The Artefact Sets, Management Artefacts, Engineering Artefacts, Programmatic Artefacts, Model Based Software Architectures: A Management Perspective and Technical Perspective

Critical Path Analysis

Unit IV: Iterative Process Planning   9 Hours
Work Breakdown Structures, Planning Guidelines, Cost and Schedule Estimating, Iteration Planning Process, Pragmatic Planning

Pragmatic Software Metrics

Unit V: Project Estimation and Management   9 Hours
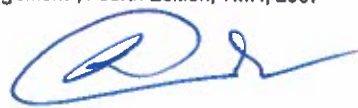COCOMO model, Critical Path Analysis, PERT technique, Monte Carlo approach

Project Control and Process Instrumentation

Textbooks

1. Walker Royce, "Software Project Management", Third Edition, Pearson Education, 2017
2. Bob Hughes, "Software Project Management", Fourth Edition, TMH, 2007

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Reference Books

1. Joel Henry, "Software Project Management", First Edition, Pearson education, 2001
2. Robert K.Wysocki, "Effective Software Project Management", First Edition, Pearson Education, 2006

Web Resources

1. www.spmresourcesglobal.com
2. www.spmflix.com

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define process
2. List the characteristics of software projects
3. Define risk profile analysis
4. What is activity plan?
5. What do you mean by project breakdown structure?
6. Define risk profile analysis
7. Define activity

L2: Understand

1. Write short notes on Hammock activities
2. What is Risk management?
3. Define a brainstorming technique
4. Explain how to get back the project to target
5. Explain the different stages in contract placement

L3: Apply

1. Mention the different categories of decisions
2. Discuss in detail about the organizational structures
3. How to calculate the net present value for a software project?
4. Difference between forward pass and backward pass
5. How are risk classified?

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PC 20DS603 Data Visualization   3   0   0   3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO2	PO3	PO5	PO12	
20DS603.1	Explain Data Visualization	3	1	1	1	L1
20DS603.2	Articulate existing visualization tools and techniques to analyse basic datasets.	3	1	1	1	L1
20DS603.3	Apply plot for data visualization	3	1	1	1	L1, L2
20DS603.4	Conduct exploratory data analysis using Tableau.	3	1	1	1	L1, L2
20DS603.5	Articulate issues and techniques for story telling	3	1	1	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Data Visualization   9 hours
Introduction, Why Look at Data? What Makes Bad Figures Bad? Perception and Data Visualization, Channels for Representing Data, Problems of Honesty and Good Judgment, Think Clearly about Graphs

Visual Tasks and Decoding Graphs

Unit II: Make a Plot & Show the Right Numbers   9hours
How Ggplot Works? Tidy Data, Mappings Link Data to Things You See, Build Your Plots Layer by Layer, Mapping Aesthetics vs Setting Them, Grouped Data and the "Group" Aesthetic, Facet to Make Small Multiples, Histograms and Density Plots

2D Histograms

Unit III: Graph Tables, Add Labels, Make Notes   9 hours
Use Pipes to Summarize Data, Continuous Variables by Group or Category, Plot Text Directly, Label Outliers, Write and Draw in the Plot Area, Understanding Scales, Guides

Understanding Themes

Unit IV: Data Visualization using Tableau   9 hours
Getting started with tableau, Importance of context in storytelling‼ Choosing the right visual, Curating visuals for your audience

Tableau Basics

Unit V: Story Telling   9 hours
Preparing data for storytelling, storyboarding frame by frame, Advanced storytelling charts, and tables, Balance the data and the context

Importance of Storytelling in Data Science

Text Books
1. Kieran Healy, "Data Visualization a practical introduction", 1st Edition, Princeton University Press, 2019 (Unit 1 to 3)
2. Lindy Ryan, "Visual Data Storytelling with Tableau", 1stEdition, Addison-Wesley Data & Analytics Series, 2018(Unit 4 to 5)

Reference Books
1. Kyran Dale, "Data visualization with python and java script", 1st Edition, O'Reilly Media, Inc., 2016
2. Claus O. Wilke, "Fundamentals of Data Visualization", 1stEdition, O'Reilly Media, Inc., 201

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Web Resources
1. https://www.kaggle.com/learn/data-visualization
2. www.sanfoundary.com
3. www.topcoder.com

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remembering
1. Define perception
2. Define Data Visualization
3. What are the channels for representing the data?
4. How Ggplot works?
5. How to use pipes to summarize the data?

L2: Understanding
1. Compare Histograms and Density plots
2. Outline the importance of context in story telling
3. Explain continuous variables by Group or Category
4. Write about the Label Outliers
5. Explain Plot text directly

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| PE | 20AI005 Cyber Security | | | 3 | 0 | 0 | 3.0 |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | DoK |
		PO1	PO2	PO3	PO12	
20AI005.1	Understand the components of cyber security	3	1	1	1	L1, L2
20AI005.2	Describe the need of security for operating systems and networks	3	1	1	1	L1, L2
20AI005.3	Explain the countermeasures of security attacks	3	1	1	1	L1, L2
20AI005.4	Understand the importance of privacy in cyber space	3	1	1	1	L1, L2
20AI005.5	Explain the implementation of organizational security	3	1	1	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Cyber Security 9 hours
Introduction -Computer Security -Threats -Types of threats – Types of attackers -Harm -Vulnerabilities – Controls -Web User Side –Browser Attack Types – Web Attacks Targeting Users – False or Misleading Content – Malicious Web Content- Protecting against Malicious Web Pages

Types of Malwares

Unit II: Security in Operating Systems and Networks 9 hours
Security in Operating Systems – Operating System Structure – Security features of Operating Systems – Network Security Attacks – Threats to Network Communications – Port Scanning – Wireless Network Security – Wi-Fi Background – Vulnerabilities in Wireless Networks- Difference between WEP and WPA – Comparison between DoS and DDoS

Protocol Layers, Address and Routing

Unit III: Security Counter measures 9 hours
Firewalls – What is a Firewall? – Design of Firewalls – Types of Firewalls – Personal Firewalls – Comparison of Firewall Types – Intrusion Detection and Prevention Systems – Types of IDSs – Intrusion Prevention System -Intrusion Response – Goals for IDS – IDS Strengths and Limitations – Databases – Security Requirements of Databases

Network Management

Unit IV: Privacy in Cyberspace 9 hours
Privacy Concepts – Privacy Principles and Policies – Privacy on the Web – Email Security – Privacy Impacts of Emerging Technology -Electronic Voting – VoIP and Skype – Privacy in the Cloud

Authentication and Privacy

Unit V: Organizational Security 9 hours
Policies, Procedures, Standards, and Guidelines – Security Awareness and Training – Physical Security – Computer Location and Facility Construction – Facilities Access Controls – Contingency Planning – Environmental Issues – Electromagnetic Eavesdropping
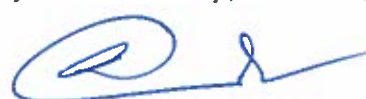
Issues and Challenges in Organizational Security

Textbooks
1. Charles P. Pfleeger, Shari Lawrence, and Pfleeger Jonathan Margulies, "Security in Computing", Fifth Edition, Pearson Edition, 2015
2. George K. Kostopoulous, "Cyber Space and Cyber Security", CRC Press, 2013

Reference Books
1. Nina Godbole,Sunit Belapure, "Cyber Security, Understanding cybercrimes, computer forensics and legal perspectives", Wiley Publications, Reprint 2016
2. Scott Barman, "Writing Information Security Policies", New Riders Publications, 2002
3. William Stallings, "Cryptography and Network security", Pearson Education, 7th Edition, 2016

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Web Resources
1. https://online.stanford.edu/professional-education/cybersecurity
2. https://www.cybrary.it/course/introduction-to-it-and-cybersecurity/
3. https://www.springboard.com/resources/learning-paths/cybersecurity-foundations/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
Total (%)	100	100

L1: Remembering
1. What is Cyber Crime? List the types of cybercriminals
2. What are the weak areas of the ITA 2000?
3. What is a Rootkit?
4. Define Mobile viruses and Mishing
5. Define the different categories of cybercrimes?
6. How to prevent SQL Injection Attacks?
7. What is the need for Computer Forensics?

L2: Understanding
1. Explain the following terms related to cybercrimes: i) Spamming ii) Salami technique iii) Hacking iv) Password sniffing
2. Discuss the global perspective on cybercrimes.
3. Define Social Engineering? Describe the classification of Social Engineering with examples.
4. Explain the following terms according to IT Act 2000: i) Records as evidence ii) Proof of electronic agreements iii) Status of electronic
5. Discuss the legal perspectives of cybercrime.
6. What are the positive aspects of the ITA 2000? Explain
7. What are the physical security countermeasures for laptops?

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PE 20CS019 Ethical Hacking   3 0 0 3

Pre- Requisites Networking, Cyber Security

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS019.1	Use the various security tools to assess the computing system and predict the vulnerabilities using penetration testing		L1, L2
20CS019.2	Identify prediction mechanism to prevent any kind of attacks		L1, L2
20CS019.3	Identify the network attacks and learn Brute Force attacks	*	L1, L2, L3
20CS019.4	Analyze the risk and support the organization for effective security measures		L1, L2
20CS019.5	Evaluate the wireless network flaws and able to apply security patches		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Hacking   9 Hours
Introduction to Hacking – Important Terminologies – Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement – Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary – Reports

Top 10 OWASP, Penetration Testing Methodologies

Unit II: Information Gathering and Scanning   9 Hours
Information Gathering Techniques – Active Information Gathering – Passive Information Gathering – Sources of Information Gathering – Tracing the Location – Traceroute – ICMP Traceroute – TCP Traceroute – Usage – UDP Traceroute – Enumerating and Fingerprinting the Webservers

Network Command Tools to Identify the System

Unit III: Network Attacks   9 Hours
Vulnerability Data Resources – Exploit Databases – Network Sniffing – Types of Sniffing – Promiscuous versus Non-promiscuous Mode – MITM Attacks – ARP Attacks – Denial of Service Attacks –Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic – DNS Spoofing, Overview of Brute Force Attacks

Dos Attack, SQL Injection

Unit IV: Exploitation   9 Hours
Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client-Side Exploitation Methods – E– Mails with Malicious Attachments – Creating a Custom Executable – Creating a Backdoor with SET – PDF Hacking – Social Engineering Toolkit – Browser Exploitation, John the Ripper – Gathering OS Information

Hashing Algorithms, Reconnaissance

Unit V: Wireless and Web Hacking   9 Hours
Wireless Hacking – Introducing Aircrack– Cracking the WEP – Cracking a WPA/WPA2 Wireless Network Using Aircracking – Evil Twin Attack, Testing for the Vulnerability – Automating It with Burp Suite – Session Attacks – SQL Injection Attacks – XSS (Cross-Site Scripting) – Types of Cross-Site Scripting – Cross-Site Request Forgery (CSRF) – SSRF Attacks

Knowledge about WEP, WPA/WPA2

Text Books
1. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2ⁿᵈ Edition, 2014.

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Reference Books

1. Kevin Beaver, "Ethical Hacking for Dummies", 6th Edition, Wiley, 2018
2. Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, Rogunix, 2007

Web References

1. https://archive.nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs68/
2. https://onlinecourses.nptel.ac.in/noc22_cs13/preview
3. https://www.mygreatlearning.com/academy/learn-for-free/courses/introduction-to-ethical-hacking

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is WEP protocol?
2. What is ICMP scanning? How is it carried out?
3. What is ping sweep explain?
4. What is the difference between HTTP and HTTPs?

L2: Understand

1. What are different types of sniffing attacks? Explain each in brief
2. Describe how a man-in-the-middle attack may be performed on a Wi-Fi network and the consequences of such an attack
3. What is vulnerability research? What is penetration testing? Explain. Why is it required? Explain the penetration testing methodology
4. Explain the difference between Active and Passive Sniffing

L3: Apply

1. While preparing to hack a targeted network, you would like to check the configuration of the DNS server. What port should you look for to attempt a zone transfer?
2. Explain Google Hacking IV1cthods with example.
3. Analyze the Network Traffic using Wireshark
4. Apply your knowledge on SQL Injection

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PE 20DS020 Digital Image Processing and Applications   3   0   0   3

Pre- Requisites Mathematics

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS020.1	Demonstrate the components of image processing		L1, L2, L3
20CS020.2	Explain various filtration techniques		L1, L2
20CS020.3	Apply image compression techniques	-	L1, L2, L3
20CS020.4	Discuss the concepts of wavelet transforms		L1, L2
20CS020.5	Analyze the concept of morphological image processing		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction   9 Hours
Introduction: Fundamental steps in digital image processing, Components of Image Processing System, Elements of Visual Perception, Image Sensing and acquisition, Image sampling & Quantization, Basic Relationship between pixels, an introduction to the mathematical tools used in digital image processing.

Need for image transforms, Discrete Fourier transform (DFT) of one variable, Haar Transform

Unit II: Image Enhancement Techniques & Filtering methods   9 Hours
Image Enhancement Techniques: Spatial Domain Methods: Basic Grey Level Transformation, Histogram Equalization, Image Subtraction, Image Averaging, Spatial Filtering: Smoothing, Sharpening Filters, Laplacian Filters

The Basics of filtering in the frequency domain, imagesmoothing using frequency domain filters, Image Sharpening using frequency domain filters

Unit III: Image Compression   9 Hours
Image Compression: Redundancies- Coding, Inter Pixel, Psycho Visual; Fidelity, Source and Channel Encoding, Elements of Information Theory; Loss Less and Lossy Compression; Run length coding, Differential encoding, DCT, Image Compression Standards-JPEG, JPEG 2000, MPEG; Video compression.

Bit-Plane Coding, Block Transform Coding, Predictive Coding

Unit IV: Wavelet Based Image Compression   9 Hours
Wavelet Based Image Compression: Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous, Wavelet Transform.

Wavelet transforms in one dimensions & two dimensions, Wavelet Coding

Unit V: Image Segmentation and Color image processing   9 Hours
Image Segmentation: Discontinuities, Edge Linking and boundary detection, Thresholding, Region Based Segmentation, basic gray-scale morphology operations; Feature extraction; Classification; Object recognition.
Color image processing: color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening.

Image segmentation based on color, noise incolor images, color image compression.

Text Books

1. Gonzalez, R.C. and Woods, R.E, "Digital Image Processing",2nd Edition, Person Education, 2009.

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2. Jayaraman, S. Esakkirajan, T. Veerakumar, "Digital Image Processing", Tata McGraw-Hill Education, 2011

Reference Books

1. John Wiley, Pratt. W. K, "Digital Image Processing", 4ᵗʰ Edition, 2001.
2. Jayaraman, S. Veerakumar, T, Esakkiranjan, S, "Digital Image Processing", 3ʳᵈ Edition, Tata McGraw-Hill, 2009.
3. B.Chanda, D.DuttaMajumder, "Digital Image Processing and Analysis", PHI, 2009.

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Image Sampling?
2. What do you meant by Gray Level?
3. What is Image Transform?
4. Draw an image for image processing system.

L2: Understand

1. Name the categories of Image Enhancement and Explain?
2. Distinguish between digital image and binary image.
3. Explain the properties of slant transform.
4. Explain about Ideal Low Pass Filter (ILPF) in frequency domain.

L3: Apply

1. Explain why the discrete histogram equalization technique does not, in general yield a flat histogram.
2. Suppose that a digital image is subjected to histogram equalization. Show that a second pass of histogram equalization will produce exactly the same result as the first pass.
3. In an automated assembly application, four classes of parts are to be color coded in order to simply detection. However, only a monochrome TV camera is available to acquire digital images. Propose a technique for using this camera to detect the four different colors.
4. Show that the saturation component of the complement of a color image cannot be computed from the saturation component of the input image alone.

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| OE | 20CEO03 Disaster Risk Mitigation and Management | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CEO03.1	Identify various types of disasters, their causes, effects & mitigation measures		L1, L2
20CEO03.2	Understand various phases of disaster management cycle and create vulnerability and risk maps		L1, L2
20CEO03.3	Understand the approaches of risk and vulnerability	-	L1, L2
20CEO03.4	Explain the concept of disaster management and emerging approaches		L1, L2
20CEO03.5	Understand the mitigation measures		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UNIT I: Natural Disasters
9 Hours

Natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.
Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation.

Ozone Depletion

Unit II: Disaster Management Principles
9 Hours

Evolution of disaster risk management concept Disaster management cycle – Prevention, Preparedness, Mitigation, Rescue and Recovery Integrated and Comprehensive disaster risk reduction approach, Strategies and Policies.

Disaster management cycle

Unit III: Risk and vulnerability
9 Hours

Hazard, risk and vulnerability: Physical, social and economic dimensions, Vulnerability in changing climate, Climate change and Disasters, Risk Analysis Techniques, Risk: Identification, reduction and transfer, Approaches to mapping social vulnerability, Participatory disaster risk assessment, Action plans, Strategy for survival.

Vulnerability in changing climate

UNIT IV: Disaster Management
9 Hours

Preparedness through (IEC) Information, education & communication, pre-disaster stage (mitigation), Effect to mitigate natural disaster at national and global levels. International strategy for disaster reduction.
Emerging approaches in Disaster Management-Concept of disaster management, national disaster management framework, financial arrangements, role of NGOs, community –based organizations and media.

National disaster management framework

UNIT V: Risk Mitigation
9 Hours

Definition, Concept, Importance, Guiding Principles, Tools, Approaches, Strategies Sustainable Development, Sustainable Land Use Planning, Technology and the Environment. Emerging Technologies in Disaster Mitigation, Remote Sensing, GIS, Disaster Mapping, Aerial Photography, Land Use Zoning

Emerging technologies in disaster mitigation

Text Books
1. Khanna, B. K., "Disasters: All you wanted to know about", New India Publishing Agency,New Delhi, 2005
2. Edwards, B., " Natural Hazards", Cambridge University Press, U.K., 2005
3. Chakraborty, S. C., "Natural Hazards and Disaster Management", Pargatishil Prokashak,Kolkata, 2007

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Reference Books

1. Sahni, P., "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, NewDelhi, 2002
2. Prashant K. Srivastava, Sudhir Kumar Singh, Mohanty, U. C., Tad Murty, "Techniques for Disaster Risk Management and Mitigation", 2020

Web References

1. https://books.google.com
2. http://cbseacademic.nic.in

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define climatic change
2. List any four effects of natural disasters
3. Define disaster Management

L2: Understand

1. Explain about risk assessment
2. Outline the principles of disaster management
3. Differentiate between hazard, risk and vulnerability

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| PC | 20CS404 Operating Systems | 3 | 0 | 0 | 3.0 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS404.1	Describe the structure, components and functionalities of operating system		L1, L2
20CS404.2	Describe the process management activities of operating system		L1, L2
20CS404.3	Illustrate the use of process synchronization tools	-	L1, L2
20CS404.4	Describe the various memory management and allocation techniques		L1, L2
20CS404.5	Demonstrate different secondary storage management strategies and file system		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Operating System Concepts
9 Hours

What Operating System Do, Operating System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments, Operating Systems Services, System Call, Types of System Call, Operating System Generation, System Boot

The Shell, Mobile Operating System, Choice of Interface

Unit II: Process Management
9 Hours

Process Concept: The Process, Process State, Process Control Block, Threads, Process Scheduling: Scheduling Queues, Schedulers, Context Switch, Operations on Processes, Inter Process Communication, Multithread Programming: Overview, Benefits, Multithreading Models, Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

Process Termination, Multiprocess Architecture

Unit III: Synchronization
9 Hours

Background, The Critical-section problem, Peterson's Solution, Synchronization hardware, Semaphores, Classic Problems of Synchronization, Monitors, Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Transactional Memory, Two Phase Locking

Unit IV: Memory Management
9 Hours

Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table, Virtual Memory Management: Background, Demand paging, Page replacement, Thrashing, Mass-Storage Structure: Overview of Mass-Storage Structure, Harddisk Drives, Volatile Memory, HDD Scheduling-FCFS Scheduling, SCAN Scheduling of a Disk-Scheduling Algorithm.

Buddy System, Prepaging

Unit V: File system Interface
9 Hours

File Concept, Access Methods, Directory and Disk Structure, File System Mounting, File Sharing, Protection, Implementing File Systems: File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

Consistency Checking, Malware, Denial of service

Text Books

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", Tenth Edition, John Wiley and Sons Inc., 2018
2. William Stallings, "Operating Systems - Internals and Design Principles", Ninth Edition, Pearson, 2018

Reference Books

1. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson, 2015
2. Charles Crowley, "Operating Systems: A Design-Oriented Approach", First Edition, Tata McGraw Hill Education, 2001

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3. Dhananjay M. Dhamdhere, "Operating Systems: A Concept-Based Approach", Third Edition, McGraw Hill Higher Education, 2017

Web Resources

1. http://nptel.ac.in/downloads/106108101/
2. https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems
3. https://www.geeksforgeeks.org/operating-system-introduction-operating-system-set-1/
4. https://www.unf.edu/public/cop4610/ree/Notes/PPT/PPT8E/CH12-OS8e.pdf
5. https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	40
L2	50	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Operating System
2. What are operating system services?
3. List any four types of system calls
4. What is a process? List any four fields of process control block
5. What are the necessary conditions for a deadlock?
6. Differentiate between binary and counting semaphore.
7. What are the various attributes that are associated with an opened file?

L2: Understand

1. Discuss the essential properties of operating systems -Batch, Interactive, Timesharing Real time and Distributive
2. Explain how multiprogramming increases the utilization of CPU
3. Why system calls are needed in operating system?
4. Distinguish between logical address and physical address
5. What is the difference between a process and thread?
6. How does the system detect thrashing? What can the system do to eliminate this problem?
7. Consider the following four processes represented as (Process, Arrival Time, Burst Time) with the length of CPU burst in milliseconds.
   { (P1, 0, 10), (P2, 1, 7), (P3, 2, 13), (P4, 3, 11) }. Using preemptive SJF scheduling: (i) Draw Gantt chart
   (ii) Calculate average waiting time.
8. Why semaphores are important? Suggest the solution for bounded buffer problem with semaphores
9. Explain the steps involved in handling a page fault with a neat sketch

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| OE | 20AIO03 Fundamentals of AI | 3 | 1 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20AIO03.1	Describe the foundational principles of artificial intelligence		L1, L2
20AIO03.2	Formalise the given problem using different AI methods		L1, L2
20AIO03.3	Explain different concepts of logic	-	L1, L2
20AIO03.4	Describe the different methods of knowledge representation		L1, L2
20AIO03.5	Explain the principles and applications of expert systems		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to Artificial Intelligence
9+3 Hours

Introduction – History - Intelligent systems - Foundations of AI – Applications – Tic-Tac-Tie game playing - Development of AI languages - Current trends in AI

Unit II: Problem Solving
9+3 Hours

Problem solving: State-Space search and Control strategies: Introduction - General problem solving - Characteristics of problem - Exhaustive searches - Heuristic search techniques – Iterative deepening A* - Constraint satisfaction - Problem reduction and game playing: Introduction - Problem reduction - Game playing – Alpha beta pruning - Two-player perfect information games

Unit III: Logic concepts
9+3 Hours

Introduction -Propositional calculus - Proportional logic - Natural deduction system - Axiomatic system - Semantic tableau system in proportional logic - Resolution refutation in proportional logic

Unit IV: Knowledge Representation
9+3 Hours

Introduction - Approaches to knowledge representation - Knowledge representation using semantic network - Extended semantic networks for KR - Knowledge representation using frames - Advanced knowledge representation techniques: Introduction - Conceptual dependency theory - Script structure - Cyctheory - Case grammars

Unit V: Expert Systems
9+3 Hours

Expert system and applications: Introduction - Phases in building expert systems - Expert system versus traditional systems - Rule-based expert systems - Blackboard systems - Truth maintenance systems - Application of expert systems

Text Books
1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007

Reference Books
4. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
5. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
6. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013

Web Resources
6. https://nptel.ac.in

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| OE | 20DSO03 Introduction to Big Data | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20DSO03.1	Identify the Knowledge of Big Data		L1, L2
20DSO03.2	Demonstrate Hadoop Framework for handling Big Data		L1, L2
20DSO03.3	Illustrate the Architectural Concepts of HDFS in Hadoop Ecosystem	-	L1, L2
20DSO03.4	Illustrate MapReduce Framework		L1, L2
20DSO03.5	Explain Spark & RDD		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Big Data   9 Hours
What is Big Data, Evolution of Big Data, Types of Big Data, Sources of Big Data,5Vs of Big Data, Big Data Analytics, Big Data Applications, Google File System

Uses of Big Data in Retail Industry

Unit II: Introduction to Hadoop   9 Hours
Introducing Hadoop, Hadoop History, Hadoop-definition, Comparing SQL Databases and Hadoop, Hadoop Cluster, Hadoop Modes, Hadoop Features, The building blocks of Hadoop, NameNode, DataNode, Secondary NameNode, Job Tracker, Task Tracker

Hadoop Cluster

Unit III: Hadoop Ecosystem &HDFS   9 Hours
Hadoop and its Ecosystem, Hadoop Ecosystem Components, Hadoop Ecosystems Tools, Hadoop Distributed File System, Concept of Block in HDFS Architecture, Features of HDFS, HDFS Read and Write Mechanism, Rack awareness in HDFS, Introducing HBase, Hive, Pig

HDFS Read/Write

Unit IV: Introduction to MapReduce   9 Hours
Hadoop MapReduce Framework, Architecture, Phases, MapReduce Job Types, Uses of MapReduce, Techniques to Optimize MapReduce Jobs, Limitations of MapReduce.

MapReduce Phases

Unit V: Introduction to Spark and RDD   9 Hours
Introduction to Spark, DataFrames - DataFrames role in Spark, Introduction to RDD, RDD operations, Creating RDDs, RDD Operations, Working with Key/Value Pairs.

DataFrames

Text Books

1. DT Editorial Services, "Big Data – Hadoop2, MapReduce, Hive, YARN, Pig, R and Data Visualization", Black Book, DreamTech Press, 2019.
2. Sridhar Alla, "Big Data Analytics with Hadoop 3" - Packt Publications, 2018.
3. Holden Karau, Andy Konwinski, Patrick Wendell & MateiZaharia, "Learning Spark" O'reilly Publications, 2015.

Reference Books

1. Chuck Lam, "Hadoop in Action", 1st Edition, MANNING Publications, 2016.
2. Balamurugan Balusamy, Nandhini Abirami R, SeifedineKadry, Amir H. Gandomi, "Big Data: Concepts, Technology, and Architecture" 1st Edition, Wiley Publications, 2021.
3. Thomas Erl, Wajid Khattak, Paul Buhler, "Big Data Fundamentals: Concepts, Drivers &Techniques", 1st Edition, Pearson Publications, 2016.

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Web Resources

1. https://hadoop.apache.org/
2. https://spark.apache.org/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
1. Define Big Data.
2. List the characteristics of Big Data.
3. Define Hadoop.
4. What are Hadoop components?
5. What are RDD operations?

L2: Understand

1. Explain HDFS Read & Write mechanism.
2. Explain Rack awareness in HDFS.
3. Explain MapReduce workflow in detail.
4. Describe the working with Key/value pairs in RDDs.

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| OE | 20ECO03 Privacy and Security in IoT | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20ECO03.1	Understand the basic knowledge of cryptography, networking and web security		L1, L2, L3
20ECO03.2	Explain Architecture of IoT and its Applications		L1, L2, L3
20ECO03.3	Understand the Attacks against IoT System	-	L1, L2, L3
20ECO03.4	Explain Secure Bootstrapping for IoT System		L1, L2, L3
20ECO03.5	Understand the IoT system security and Trust zone		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Cryptography and Network Securities
9 Hours

Cryptography , networking, Web Security: Secure socket layer and transport layer security, System Security: Intruders , Viruses and related threads, trusted systems.

Secure Shell (SSH)

Unit II: Introduction to IoT
9 Hours

Internet of Things (IoT), Need of IoT, Applications, Architecture, Enabling technologies, IoT security and privacy.

IoT protocols

Unit III: Attacks against IoT
9 Hours

Attacks against IoT system (hardware + software), Attacks against IoT network protocols, Attacks against industry IoT

Attacks against Web systems

Unit IV: Secure Bootstrapping for secure IoT system
9 Hours

Trusted boot, Secure boot, TPM and its usages, Remote attestation, tamper resistant-proof-response hardware and its usage

Bootstrapping for IoT

Unit V: IoT System Security and TrustZone
9 Hours

System security, TrustZone hardware architecture, TrustZone software architectures.

Web security

Text Books

1. Syed Rameem Zahra, Mohammad Ahsan Chishti ,"Security and Privacy in the Internet of Things " 1st Edtion ,Chapman & Hall, 2020
2. Fei Hu ,"Security and Privacy in Internet of Things (IoTs) Models, Algorithms, and Implementations", 1st Edition CRC Press

Reference Books

1. Ravi Ramakrishnan, Loveleen Gaur "Internet of Things Approach and Applicability in Manufacturing " , 1st Edtion ,Chapman & Hall, 2019
2. Vijay Madisetti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", UniversityPress,2015

Web Resources

1. https://lss.at.ufl.edu/help.shtml
2. http://cms.uflib.ufl.edu/ask

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Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is cryptography ?
2. List the applications of IoT
3. What is Attacks against IoT system ?

L2: Understand

1. Explain about networking
2. Explain Enabling technologies of IoT
3. Explain Attacks against IoT network protocols

L3: Apply

1. Discus about web security
2. Write about Architecture of IoT
3. Explain Attacks against industry IoT

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| OE | 20EEO03 Low Cost Automation | | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20EEO03.1	Understanding automation of assembly lines		L2
20EEO03.2	Automation Using Hydraulic Systems		L2
20EEO03.3	Describe Automation Using Pneumatic Systems	-	L2
20EEO03.4	Explain Automation Using Electronic Systems		L2
20EEO03.5	Explain Assembly Automation		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

UNIT I : Automation Of Assembly Lines
9 Hours

Concept of automation-mechanization and automation - Concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms -Transfer line-monitoring system (TLMS) using Line Status - Line efficiency - Buffer stock Simulation in assembly line

Transfer line-monitoring system (TLMS) using Line Status ,Line efficiency

UNIT II: Automation Using Hydraulic Systems
9 Hours

Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - Servo valves, electro hydraulic valves, proportional valves and their applications.

Servo valves, electro hydraulic valves, proportional valves and their applications.

UNIT III: Automation Using Pneumatic Systems
9 Hours

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic equipments - selection of components - design calculations -application - fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Low cost automation - Robotic circuits

UNIT IV: Automation Using Electronic Systems
9 Hours

Introduction - various sensors – transducers - signal processing - servo systems - programming of microprocessors using 8085 instruction - programmable logic controllers

Programming of microprocessors using 8085 instruction - programmable logic controllers

UNIT V: Assembly Automation
9 Hours

Types and configurations - Parts delivery at workstations - Various vibratory and non-vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - Product design for automated assembly.

Product design for automated assembly.

Text Books
1. Anthony Esposito, "Fluid Power with applications", Prentice Hall international, 2009.
2. Mikell P Groover-"Automation, Production System and Computer Integrated Manufacturing", Prentice Hall, Publications, 2007

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Reference Books

1. Kuo .B.C, "Automatic control systems", Prentice Hall India, New Delhi, 2007.
2. Peter Rohner, "Industrial hydraulic control", Wiley Edition, 1995.
3. Mujumdar.S.R, "Pneumatic System", Tata McGraw Hill 2006.

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is automation?
2. What is Pneumatic fundamentals?
3. What is transducers?
4. What is switching circuits?
5. What is Buffer stock Simulation?

L2: Understand

1. Explain Line efficiency.
2. Explain Selection of hydraulic fluid.
3. Explain Pneumatic equipments
4. Explain programmable logic controllers.
5. Explain Parts delivery at workstations.

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| OE | 20MEO03 Industrial Automation | | | 3 0 0 3 |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20MEO03.1	Identify various concepts of automation and work part transport mechanisms.	-	L2
20MEO03.2	Illustrate the assembly systems and their applications.	-	L3
20MEO03.3	Describe the importance of handling systems and identification systems.	-	L3
20MEO03.4	Apply the concepts of part families and machine cells into various production systems	-	L2
20MEO03.5	Recognize the importance of automated inspection and to distinguish the various control systems	-	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

Unit I: Manufacturing and Automation-Over View
9 Hours

Production systems, Automation in production systems, Automation principles and strategies, Reasons for Automation, Manufacturing operations, Functions in Manufacturing, Information processing in Manufacturing plant layout, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers. Automation for machining operations.

Unit II: Assembly Systems and Line Balancing
9 Hours

Process-Assembly lines-manual single stations assembly, Manual assembly line, automated assembly system-Line balancing. Automated Assembly Systems – Design for automated assembly-Types of automated assembly systems-Parts feeding devices

Unit III: Automated Material Handling Systems
9 Hours

Automated Material Handling and storage system: Material Handling and Identification Technologies: Material handling, equipment, Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Functions, material handling equipment-Conveyors, AGVS, Industrial Robots-Anatomy, Robot configurations, work volume-AS/RS. Automatic identification methods, Barcode technology, RFID

Unit IV: Manufacturing Cells
9 Hours

Manufacturing Systems and Automated Production Lines: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells, Automated production lines, Applications, Transfer lines

Unit V: Control Systems
9 Hours

Control Systems-Process Industries Versus Discrete Manufacturing Industries, Continuous Versus Discrete Control: Continuous Control Systems, Discrete Control Systems, Computer Process Control: Control Requirements, Capabilities of Computer Control.

.

Text Books .
1. Milkell P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Kindle Edition, Prentice Hall of India, 2016.

Reference Books
1. C. Roy, "Robots and Manufacturing Automation", Asfahl John Wiley & Sons
2. Krishna Kant, "Computer Based Industrial Control", EEE-PHI, 2nd edition, 2010

Web References
1. www.nptel.iitm.ac.in
2. www.btechguru.com

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Internal Assessment Pattern

Cognitive Level	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	40	30
L2	40	30
L3	20	40
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is industrial automation?
2. What are the different costs included in industry in designing the particular product ?
3. What is production volume?
4. List the categorization of production system.
5. What are the types of automation?
6. What are the features of Flexible Automation?
7. What is factory type of Integral automation?
8. Define process.
9. What are process variables?
10. What is meant by control system in automation?

L2: Understand

1. Explain Automation principles and strategies
2. Compare Manual assembly line, automated assembly system
3. Illustrate Material handling, equipment, Storage systems, performance and location strategies
4. Demonstrate components of a manufacturing system
5. Compare Continuous Control Systems, Discrete Control Systems

L3: Apply

1. Apply the basic elements of an automated system for industrial automation
2. Apply different types of automated assembly systems for moderate plants
3. Apply the Barcode technology, RFID for industrial automation
4. Discuss Automated production lines, Applications, Transfer lines
5. Design the capabilities of computer control systems

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| OE | **20SHO02 Design Thinking** | | **3** | **0** | **0** | **3** |

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20SHO02.1	Explain the fundamentals of Design Thinking and innovation		L2
20SHO02.2	Empathize and analyse model action plan		L2
20SHO02.3	Describe the principles of innovation and idea generation for product design	-	L2
20SHO02.4	Apply design thinking techniques for given tasks		L2
20SHO02.5	Apply the design thinking techniques for solving problems in various sectors		L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction to Design Thinking
9 Hours

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry

Unit II: Design Thinking
9 Hours

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development

Unit III: Innovation
9 Hours

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity. Product Design: problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications

Unit IV: Design Thinking for Strategic Innovation
9 Hours

An exercise in design thinking – implementing design thinking for better process. Implement design thinking process in various Industries. Design thinking for Start-ups

Unit V: Design thinking in Various Sectors
9 Hours

Case studies in Information Technology, Finance, Education, Management and Retail sector. Analyze and Prototyping, Usability testing, Organizing and interpreting results

Case study learning outcomes:
1. Make use of practical design thinking methods in every stage of problem with the help of method templates
2. Apply design thinking to a problem in order to generate innovative and user-centric solutions
3. Empathize with end user and initiate a new working culture based on user-centric approach
4. Prototype and run usability tests for unbiased examination of the product in order to identify problem

Text Books

1. Tim Brown, Harper Bollins, Change by Design, 2009
2. David Lee, Design Thinking in the Class Room, Ulysses Press

Reference Books

1. Design the Future, Shrrutin N Shetty, Norton Press
2. William Lidwell, Kritina Holden, Jill Butter, Universal Principles of Design
3. Chesbrough H., The Era of Open Innovation
4. Chitale A. K. and Gupta R. C., Product Design and Manufacturing, Prentice Hall

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Web References

1. https://nptel.ac.in/courses/110106124
2. https://onlinecourses.nptel.ac.in/noc19_mg60/preview
3. www.tutor2u.net/business/presentations/. /productlifecycle/default.html
4. https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf
5. www.bizfilings.com › Home › Marketing › Product Development
6. https://www.mindtools.com/brainstm.html
7. https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit
8. www.vertabelo.com/blog/documentation/reverse-engineering https://support.microsoft.com/en-us/kb/273814
9. https://support.google.com/docs/answer/179740?hl=en
10. https://www.youtube.com/watch?v=2mjSDIBaUIM
11. thevirtualinstructor.com/foreshortening.html
12. https://dschool.stanford.edu/.../designresources/.../ModeGuideBOOTCAMP2010L.pdf
13. https://dschool.stanford.edu/use-our-methods/ 6.
14. https://www.interactiondesign.org/literature/article/5-stages-in-the-design-thinking-process 7.
15. https://www.nngroup.com/articles/design-thinking/ 9.
16. https://designthinkingforeducators.com/design-thinking/ 10.
17. www.designthinkingformobility.org/wp-content/.../10/NapkinPitch_Worksheet.pdf

Activity Based Learning (Suggested Activities in Class) / Practical Based learning

http://dschool.stanford.edu/dgift/

Internal Assessment Pattern

Cognitive Level	Internal Assessment # 1 (%)	Internal Assessment # 2 (%)
L1	20	20
L2	50	50
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What do you mean by design thinking?
2. How design thinking works within a product development process

L2: Understand

1. Explain the elements and principles of design
2. Differentiate between creativity and innovation

L3: Apply

1. How design thinking helped financial sector to gain the consumer 'trust'?

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HS   20HSX04 Professional Ethics   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO8	PO12	
20HSX04.1	Understand the ethics and apply ethics in society	3	1	L1, L2, L3
20HSX04.2	Discuss the ethical issues related to engineering and realize the responsibilities and rights in the society	3	1	L1, L2, L3
20HSX04.3	Know the code of ethics and industrial standards	3	1	L1, L2, L3
20HSX04.4	Understand the rights and responsibilities of an employee at workplace	3	1	L1, L2, L3
20HSX04.5	Understand environmental ethics and CSR of companies	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Ethics   9 Hours
Need and importance of ethics, objectives, morals, values and ethics – integrity – work ethic – service learning – civic virtue – respect for others – living peacefully – honesty – courage – valuing time – cooperation – commitment – empathy – self-confidence.

Unit II: Engineering Ethics   9 Hours
Senses of 'engineering ethics' – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – consensus and controversy – models of professional roles – self-interest – self respect - customs and religion.

Unit III: Engineering as Social Experimentation   9 Hours
Engineering as experimentation – engineers as responsible experimenters – codes of ethics – industrial standards - a balanced outlook on law.

Unit IV: Safety, Responsibilities and Rights   9 Hours
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis - Safety lessons from Challenge - Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights.

Unit V: Global Issues   9 Hours
Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers–Moral Leadershi p– Code of Conduct– Corporate Social Responsibility.

Text Books

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003
2. Govindarajan M., Natarajan S., Senthil Kumar V. S., "EngineeringEthics", Prentice Hall of India, New Delhi, 2004

Reference Books

1. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for PersonalIntegrity and Social Responsibility" McGraw Hill Education, India Pvt. Ltd., New Delhi, 2013, Web References
2. World Community Service Centre, ' Value Education', Vethathiri Publications, Erode, 2011
3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009

Web References

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

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Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List the human values and explain
2. Give an overview of Engineering Ethics
3. What is meant by Professional Responsibility?
4. What are the safety lessons one can learn in the Challenger case?
5. What are employee rights?
6. What is the engineer's role in weapon development?

L2: Understand

1. Illustrate the ethical aspect principle of caring or sharing, with an example
2. Explain various actions of an engineer leading to dishonesty
3. Justify the safety and other obligations of professional engineers
4. Discuss the problems with law in engineering practice
5. Explain in detail about the effect of information on risk assessments
6. Explain the role of engineers as 'expert witness' and 'advisors'

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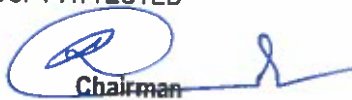
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| SC | 20CSS05 Finishing School for CSE | 0 | 0 | 4 | 2 |

At the end of the course,

Code	Course Outcomes	Mapping with POs	DoK
20CSS05.1	Eligible students should be employable	PO1-PO12	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

AWS, Full Stack, Azure, Power BI, Network Security, New age skill set

1. https://www.edureka.co/blog/aws-vs-azure/
2. https://www.simplilearn.com/tutorials/cloud-computing-tutorial/aws-vs-azure
3. https://powerbi.microsoft.com/en-au/
4. https://www.udemy.com/course/microsoft-power-bi-up-running-with-power-bi-desktop/

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IN   **Summer Internship #2**   **0   0   0   3.0**

At the end of the course, students will be able to

No.   Course Outcomes

1   Demonstrate the theoretical learning outcomes
2   Integrate theory and practice during graduation
3   Comprehend the industry practices in the relevant and allied field of study
4   Develop communication skills in terms of oral, written, and graphical communications
5   Develop problem solving skills
6   Exhibit work habits and teamwork in a multidisciplinary setting for a successful career after graduation

Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes

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Full Semester Internship   0   0   0   6

At the end of the course, students will be able to

No.   Course Outcomes
1   Recognizes and articulates the conceptual knowledge involved in the task undertaken
2   Use the appropriate resources required to accomplish the task
3   Demonstrate the theoretical learning outcomes of the domain in task undertaken
4   Communicate well in various forms appropriately
5   Demonstrate a professional behavior with improved inter-personal skills
6   Coordinate with people from inter and multi-disciplinary setting

Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes

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Capstone Project   0   0   0   6

At the end of the course, students will be able to

No.   **Course Outcomes**
1   Demonstrate the application of theoretical concepts of domain
2   Identify the appropriate tools and methodologies for accomplishing the project
3   Illustrate the use of project management principles
4   Demonstrate the various forms of communication
5   Exhibit professional behavior with inter and multi-disciplinary settings

Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes

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HO **20CSH01 Advanced Computer Architecture**   4   0   0   4.0

At the end of the course, students will be able to

Code	Course Outcomes
20CSH01.1	Understand the parallelism concepts in programming
20CSH01.2	Analyze processors, memory technologies and virtual memory
20CSH01.3	Understand the bus systems and analyze the working of pipelining
20CSH01.4	Understand about multiprocessors, multicomputer and SIMD computers
20CSH01.5	Analyze the techniques to explore instruction level parallelism

Unit I: Theory of Parallelism: **9 Hours**
Parallel Computer Models, The State of Computing, Multiprocessors and Multi-computer, Multi vector and SIMD Computers, PRAM and VLSI Models, Program and Network Properties, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallelism profile in programs, Mean performance, Harmonic Mean Performance, Amdahl's law

Arithmetic Mean Performance

Unit II: Processors and Memory Hierarchy: **9 Hours**
Processors and Memory Hierarchy, Advanced Processor Technology, Super scalar and Vector Processors, Memory Hierarchy Technology-hierarchical memory technology, inclusion, coherence and locality, Virtual Memory Technology-Virtual memory models, TLB, Paging and segmentation

FIFO & Circular FIFO

Unit III: Bus, Cache and Shared memory, Pipelining and Superscalar Techniques: **9 Hours**
Bus Systems, Backplane bus specification, Arbitration, transaction and interrupt, Cache Memory Organizations, cache addressing models, Direct mapping and associative caches, Sector-cache, Shared Memory Organizations, Memory interleaving, Pipelining and Super scalar Techniques, Linear Pipeline Processors, Instruction Pipeline Design, Instruction execution phases, mechanisms for instruction pipelining, Dynamic instruction scheduling, branch handling techniques

Set-Associative cache

Unit IV: Multiprocessors, Multicomputer, Multivector and SIMD computers: **9 Hours**
Multiprocessors and Multicomputer, Multiprocessor System Interconnects, Hierarchical bus system, cross bar switch and multiport memory, Cache Coherence and Synchronization Mechanisms, Cache coherence problem, snoopy bus protocols, Three Generations of multicomputer, Message-Passing Mechanisms, message routing schemes
Multivector and SIMD Computers, Vector Processing Principles, Vector Instruction types, Vector Memory Access schemes, Compound Vector Processing, compound vector operations, SIMD Computer Organizations, Implementation models

Flow control strategies

Unit V: Instruction and System level parallelism: **9 Hours**
Instruction Level Parallelism, Introduction, basic design issues, Problem definition, Resource dependence Compiler, detected Instruction Level Parallelism, Operand Forwarding, Reorder Buffer, Register Renaming, Tomasulo's Algorithm, Branch Prediction

Limitations in Exploiting Instruction Level Parallelism

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Text Books
1. Kai Hawang and Naresh Jotwani, "Advanced Computer Architecture-Parallelism, Scalability, Programmability", Third Edition, McGraw Hill Education Private Limited, 2015
2. Sima D. and Fountain T., "Advanced Computer Architectures: A Design Space Approach", First Edition, Pearson Education India, 2002

Reference Books
1. John L. Hennessy and David A. Patterson, "Computer Architecture: A quantitative approach", 5th edition, Morgan Kaufmann Elsevier, 2013
2. Shiva S.G., "Advanced Computer Architectures", First Edition, CRC Press, 2018

Web Resources
1. https://nptel.ac.in/courses/106/103/106103206/
2. https://www.mhhe.com/hwang/aca3

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	35	40
L3	35	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
1. Define the following terms
   (i) Computer architecture   (ii) Response time
2. What is cache coherence problem?
3. What is pipelining?
4. What is virtual memory?
5. Write a short note on instruction level parallelism

L2: Understand
1. Describe the program flow mechanism
2. Explain the hierarchical memory technology with a neat diagram
3. Give a brief note on inclusion, coherence and locality
4. Explain briefly about basic VLIW approach
5. Explain briefly about basic compiler techniques for exposing ILP

L3: Apply
1. A 400-MHz processor was used to execute a benchmark program with the following instruction mix and clock cycle counts:

Instruction type	Instruction count	Clock cycle count
Integer arithmetic	45,000	1
Date transfer	32,000	2
Floating point	15,000	2
Control transfer	8,000	2

   Determine the effective CPI, MIPS rate and execution time for this program.
2. Derive an expression for CPU clock as a function of instruction count, clocks per instruction and clock cycle time
3. Assume we have a computer where the cycles per instruction (CPI) is 1.0 when all memory accesses hit in the cache. The only data accesses are loads and stores, and these total 50% of the instructions. If the miss penalty is 25 clock cycles and the miss rate is 2%, how much faster would the computer be if all instructions were cache hits?

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HO 20DSH01 Text Analytics

4	0	0	4.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20DSH01.1	Understand the basic concepts of Natural Language Processing		L1, L2
20DSH01.2	Understand the text analytics framework.		L1, L2
20DSH01.3	Understand the concepts of Text Summarization.		L1, L2
20DSH01.4	Apply different techniques on Text Similarity	-	L1, L2, L3
20DSH01.5	Analysing the concepts of Semantic and Sentiment Analysis		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Natural Language Basics
9 hours

Natural Language: Philosophy of Language, Acquisition and Usage, Language Syntax and Structure, Language Semantics, Natural Language Processing: Machine Translation, Speech Recognition Systems, Question Answering Systems, Contextual Recognition and Resolution, Text Categorization, Text Summarization, Text Analytics

Speech Recognition System versus Contextual Recognition system

Unit II: Text Classification
9hours

Automated Text Classification, Classification Algorithms: Multinomial Naïve Bayes, Support Vector Machines, Evaluating Classification Models, Building a Multi-Class Classification System, Applications and Uses, Feature Extraction: Bag of Words Model, TF-IDF Mode, Advanced Word Vectorization Models, Understanding Text Syntax and Structure: Parts of Speech (POS) Tagging, Dependency based Parsing, Shallow Parsing, Constituency-based Parsing

Decision tree

Unit III: Text Summarization
9 hours

Text Summarization and Information Extraction: Text Normalization, Feature Extraction: Keyphrase Extraction, Weighted Tag–Based Phrase Extraction, Topic Modelling: Latent Semantic Indexing, Latent Dirichlet Allocation, Matrix Factorization, Automated Document Summarization, Latent Semantic Analysis

Non-negative Matrix Factorization

Unit IV: Text Similarity and Clustering9 hours

Information Retrieval (IR), Feature Engineering, Similarity Measures: Analysing Term Similarity, Manhattan Distance, Euclidean Distance, Analyzing Document Similarity: Cosine Distance and Similarity, Document Clustering: K-means Clustering, Ward's Agglomerative Hierarchical Clustering

Hamming Distance, K-NN Clustering

Unit V: Semantic and Sentiment Analysis9 hours

Semantic Analysis: Analyzing Lexical Semantic Relations, Word Sense Disambiguation, Named Entity Recognition, Propositional Logic, First Order Logic. Sentiment Analysis: Supervised Machine Learning Technique, Unsupervised Lexicon-based Techniques, Comparing Model Performances

Semantic Representations

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Text Books

1. Dipanjan Sarkar, "Text Analytics with Python : A Practitioner's Guide to Natural Language", 2nd Edition, Apress, 2019
2. Akshay Kulkarni, Adarsha Shivananda, "Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning Using Python", 1st Edition, Apress, 2019

Reference Books

1. Birds.,KlienE. and E.Loper, "Natural Language Processing with python", 1st Edition ,O 'Reilly Media Inc, 2009

Web Resources

1. https://www.tutorialspoint.com/big_data_analytics/text_analytics.htm
2. https://towardsdatascience.com/getting-started-with-text-analysis-in-python-ca13590eb4f7

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	35
L2	40	35
L3	20	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Natural Language Processing?
2. List out the three phases of transfer model in Machine Translation.
3. What is POS tagging?
4. Define k-means clustering
5. What do you mean by natural language and computer language?

L2: Understand

1. Explain the process of multi-document summarization.
2. Discuss about NLP and NLU
3. Describe two evaluation metrics available for text classification
4. Explain text summarization and multiple document text summarization with neat diagram
5. Explain about Ward's Agglomerative Hierarchical Clustering

L3: Apply

1. Apply the naive Bayes classifier approach to Word Sense Disambiguation in NLP
2. Apply the significance of Word Sense Disambiguation in NLP
3. Evaluate the architecture of an Information Retrieval system with a neat diagram

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HO 20AIH03 Game Theory   4   0   0   4

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20AIH03.1	Understand the fundamentals of game theory		L1, L2
20AIH03.2	Describe the principles of computer graphics		L1, L2
20AIH03.3	Explain the basic principles of game designing	-	L1, L2
20AIH03.4	Explain game engine design methods		L1, L2
20AIH03.5	Design and develop simple games		L1, L2, L3

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction   9 hours
Elements of Game Play – Artificial Intelligence – Getting Input from the Player - Sprite Programming – Sprite Animation - Multithreading – Importance of Game Design – Game Loop

Unit 2: 3D Graphics for Game Programming   9 hours
Coordinate Systems, Ray Tracing, Modelling in Game Production, Vertex Processing, Rasterization, Fragment Processing and Output Merging, Illumination and Shaders, Parametric Curves and Surfaces

Unit 3: Game Design Principles   9 hours
Character Development, Story Telling, Narration, Game Balancing, Core mechanics, Principles of level design, Genres of Games, Collision Detection, Game Logic, Game AI, Path Finding, Case study : Tetris

Unit 4: Game Engine Design   9 hours
Renderers, Software Rendering, Hardware Rendering, and Controller Based Animation, Spatial Sorting, Level of Detail, Collision Detection, Standard Objects

Unit 5: Game Development   9 hours
Developing 2D and 3D Interactive Games Using OpenGL, DirectX – Isometric and Tile Based Games, Puzzle Games, Single Player Games, Multi-Player Games

Text Books
1. David H. Eberly, "3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics", Second Edition, Morgan Kaufmann, 2010.
2. 2. Jung Hyun Han, "3D Graphics for Game Programming", First Edition, Chapman and Hall/CRC, 2011

Reference Books
1. Jonathan S. Harbour, "Beginning Game Programming", Course Technology, Third Edition PTR, 2009.
2. Ernest Adams and Andrew Rollings, "Fundamentals of Game Design", Third Edition, Pearson Education, 2014.
3. Scott Rogers, "Level Up: The Guide to Great Video Game Design", First Edition, Wiley, 2010.
4. Jim Thompson, Barnaby Berbank-Green, and Nic Cusworth, "Game Design: Principles, Practice, and Techniques - The Ultimate Guide for the Aspiring Game Designer", First Edition, Wiley, 2008

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

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HO 20CSH04 GPU Architecture and Programming   4   0   0   4

At the end of the course, students will be able to

Code   **Course Outcomes**

20CSH04.1   Explain the architecture of Graphical Processor Unit
20CSH04.2   Design simple programs using CUDA
20CSH04.3   Understand the issues with programming in GPU environment
20CSH04.4   Write simple programs using OpenCL
20CSH04.5   Identify efficient parallel programming patterns to solve problems

Unit I: GPU Architecture   12 Hours
Evolution of GPU architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

Unit II: Multi Processor Architecture   12 Hours
Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions

Unit III: Issues in Programming   12 Hours
Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

Unit IV: OPENCL Basics   12 Hours
OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.

Unit V: Algorithms on GPU   12 Hours
Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.

Text Books

1. Shane Cook, "CUDA Programming: –A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)", First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL", Third Edition, Morgan Kauffman, 2015.

Reference Books

1. Nicholas Wilt, "CUDA Handbook: A Comprehensive Guide to GPU Programming", 1st Edition, Addison- Wesley, 2013.
2. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPU Programming", Wesley, 2010
3. David B. Kirk, Wen-Mei W. Hwu, "Programming Massively Parallel Processors – A Hands-on Approach", 3rd Edition, Morgan Kaufmann, 2016.
4. http://www.nvidia.com/object/cuda_home_new.html
5. http://www.openCL.org

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Web Resources

1. http://www.nptelvideos.in/2012/11/high-performance-computing.html

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HO 20DSH04 Recommender Systems   4   0   0   4

At the end of the course, students will be able to

Code	Course Outcomes
20DSH04.1	Design recommendation system for a particular application domain.
20DSH04.2	Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity.
20DSH04.3	Explain User-based recommendation, knowledge-based recommender system.
20DSH04.4	Define Opportunities for hybridization, Monolithic hybridization.
20DSH05.5	Identify hybridization design, Weighted, Switching, Mixed, Pipelined hybridization.

Unit I: Introduction   **12Hours**
Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

Information Retrieval

Unit II: Content-based Filtering   **12 Hours**
High level architecture of content-based systems, Advantages and drawbacks of content-based filtering, Item profiles, discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

Pre-processing

Unit III: Collaborative Filtering   **12 Hours**
User-Based Recommendation, Item-Based Recommendation, Model Based Approaches, Matrix Factorization, Attacks on Collaborative Recommender Systems, Types of Recommender Systems: Recommender Systems in Personalized Web Search Knowledge-based Recommender System, Social Tagging Recommender Systems, Trust-Centric Recommendations, Group Recommender Systems

Matrix factorization

Unit IV: Hybrid Approaches   **12 Hours**
Opportunities for Hybridization, Monolithic Hybridization Design: Feature Combination, Feature Augmentation, Parallelized Hybridization Design: Weighted, Switching, Mixed, Pipelined Hybridization Design: Cascade, Meta-level, Limitations of Hybridization Strategies.

Feature augmentation

Unit V: Evaluating Recommender System   **12 Hours**
Introduction, General Properties of Evaluation Research, Evaluation Designs: Accuracy, Coverage, Confidence, Novelty, Diversity, Scalability, Serendipity, Evaluation on Historical Datasets, Offline Evaluations

Evaluation on historical datasets

Text Books

1. Jannach D, Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press, 1st Edition, 2011
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 1st Edition, 2016

Reference Books

1. Ricci F, Rokach L., Shapira D, Kantor B.P., Recommender Systems Handbook, Springer, 1st Edition, 2011
2. Manouselis N, Drachsler H, Verbert K, Duval E., Recommender Systems for Learning, Springer, 1st Edition, 2013

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Web Resources

2. www.geeksforgeeks.com
3. www.sanfoundary.com

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| HO | 20AIH06 Game Programming | 4 | 0 | 0 | 4 |

At the end of the course, students will be able to

Code	Course Outcomes
20AIH06.1	Explain the game logic and game theory
20AIH06.2	Discuss the concepts of Game design and development
20AIH06.3	Explain the Core architectures of Game Programming
20AIH06.4	Explain the Concepts of software and hardware rendering
20AIH06.5	Create interactive Games

Unit 1: Introduction   **12 Hours**
Introduction, Game Logic, Game AI, Path Finding, Game Theory, Character development, Story Telling, Narration, Game Balancing, Core mechanics, Principles of level design, Genres of Games, Collision Detection

Unit 2: 3D Graphics for Game Programming   **12 Hours**
Coordinate Systems, Ray Tracing, Modelling in Game Production, Vertex Processing, Rasterization, Fragment Processing and Output Merging, Illumination and Shaders, Parametric Curves and Surfaces

Unit 3: Game Engine Design   **12 Hours**
Game engine architecture, Engine support systems, Resources and File systems, Game loop and real-time simulation, Human Interface devices, Collision and rigid body dynamics, Game profiling

Unit 4: Game Programming   **12 Hours**
Renderers, Software Rendering, Hardware Rendering, and Controller Based Animation, Spatial Sorting, Level of Detail, Collision Detection, Standard Objects

Unit 5: Game Development   **12 Hours**
Developing 2D and 3D Interactive Games Using OpenGL, DirectX – Isometric and Tile Based Games, Puzzle Games, SinglePlayer Games, Multi-Player Games

Text Books
1. Mike Mc Shaffrfy and David Graham, "Game Coding Complete", Fourth Edition, Cengage Learning, PTR, 2012.
2. Jason Gregory, "Game Engine Architecture", CRC Press / A K Peters, 2009.
3. David H. Eberly, "3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics" 2nd Editions, Morgan Kaufmann, 2006.

Reference Books
1. Ernest Adams and Andrew Rollings, "Fundamentals of Game Design", 2nd Edition Prentice Hall / New Riders, 2009.
2. Eric Lengyel, "Mathematics for 3D Game Programming and Computer Graphics", 3rd Edition, Course Technology PTR, 2011.
3. Jesse Schell, The Art of Game Design: A book of lenses, 1st Edition, CRC Press, 2008.

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HO 20CSH07 Fault Tolerant Computing   4   0   0   4

At the end of the course, students will be able to

Code	Course Outcomes
20CSH07.1	Know the fundamentals of Fault Tolerance
20CSH07.2	Understand various forms of Hardware Redundancy and Techniques
20CSH07.3	Understand the Errors in Data and Common Forms of Information Redundancy
20CSH07.4	Understand Several Measures of Resilience / Fault Tolerance in Networks and Software
20CSH07.5	Understand the fault-tolerance aspects of six different computer systems that have various fault-tolerance techniques implemented in their design

Unit I: Introduction   12 Hours
Overview of Fault Tolerance Computing, Fundamental Definitions- Faults, Errors, Failures, Characteristics of Faults, Fault Models, Error Models, Fault Tolerance via Redundancy, Different Forms of Redundancy

Unit II: Hardware Fault Tolerance   12 Hours
Passive Hardware Redundancy, Triple/N Modular Redundancy, Voting Techniques, Active Hardware Redundancy, and Hybrid Techniques; Fault Tolerance at Processor Level; Byzantine Failures

Unit III: Information Redundancy   12 Hours
Introduction, Coding, Resilient Disk Systems, Data Replication, Algorithm-based Fault Tolerance

Unit IV: Fault Tolerant Networks and Software Fault Tolerance   12 Hours
Measures of Resilience, Common Network Topologies and their Resilience, Acceptance Tests, Single-Version Fault Tolerance, Exception Handling, Software Reliability Models

Unit V: Case Studies   12 Hours
Nonstop systems, Stratus systems, Cassini command and data subsystem

Text Books

1. Korean, M. Krishna, "Fault Tolerance Systems", Morgan Kaufmann, 2007, San Francisco, CA

Reference Books

1. M. L. Shooman, "Reliability of Computer Systems and Networks", Wiley Inter Science, New York, NY, 2002
2. L. Pullum, "Software fault tolerance techniques and implementation", Artech House, Norwood, MA, 2001
3. W. Johnson, "Design and Analysis of Fault-Tolerant Digital Systems", Addison Wesley, Reading, MA, 1989

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Web References

1. http://www2.cs.uidaho.edu/~krings/CS449/
2. https://nptel.ac.in/courses/106106168
3. http://cse.iitkgp.ac.in/~soumya/fts/attempt3/fts3.html

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| HO | 20DSH07 Data Analysis with MATLAB | 4 | 0 | 0 | 4 |

At the end of the course, students will be able to

Code	Course Outcomes
20DSH07.1	Identify how to prepare the data for analysis
20DSH07.2	Describe linear regression analysis
20DSH07.3	Apply the Fourier analysis and calculate FFT
20DSH07.4	Illustrate about time series objects and methods
20DSH07.5	Demonstrate time series tools

Unit I Preparing Data for Analysis: **12 Hours**
MATLAB for Data Analysis: Introduction, Calculations on Vectors and Matrices, MATLAB GUIs for Data Analysis Related Toolboxes, Importing and Exporting Data, Plotting Data: Introduction, Example-Loading and Plotting Data, Removing and Interpolating Missing Values: Representing Missing Data Values, Calculating with NaNs, Removing NaNs from the Data, Interpolating Missing Data, Removing Outliers

Unit II Linear Regression Analysis: **12 Hours**
Linear Regression: Introduction, Residuals and Goodness of Fit, When to Use the Curve Fitting Toolbox, Correlation Analysis: Introduction, Covariance, Correlation Coefficients, Interactive Fitting: The Basic Fitting GUI, Preparing for Basic Fitting, Opening the Basic Fitting GUI, Programmatic Fitting: MATLAB Functions for Polynomial Models

Unit III Fourier Analysis   **12 Hours**
Fourier Analysis-Introduction: Function Summary, Calculating Fourier Transforms, Example-Using FFT to Calculate Sunspot, Magnitude and Phase of Transformed Data

Unit IV Time Series Objects and Methods   **12 Hours**
Time Series Objects: Introduction: Time Series Data Sample, Example — Using Time Series Objects and Methods: Creating Time Series Objects, Viewing Time Series Objects, Modifying Time Series Units and Interpolation Method, Defining Events, Time Series Methods: General Methods, Data and Time Manipulation Methods, Event Methods

Unit V Time Series Tools   **12 Hours**
Introduction-Opening Time Series Tools, Getting Help, Time Series Tools Window, Time Series Tools Workflow, Generating Reusable M-Code, Importing and Exporting Data: Types of Data You Can Import, How to Import Data, Changes to Data Representation During Import, Importing Data with Missing Values, Plotting Time Series: Types of Plots in Time Series Tools, Creating a Plot

Text Books
1. "Matlab 7 Data Analysis", The MathWorks, 2007

Reference Books
1. Irfan Turk, "Practical MATLAB", Apress, 2019
2. Arash Karimpour, "Fundamentals of Data Science with MATLAB", Arash Karimpour, 2020

Web Resources
1. https://in.mathworks.com/videos/matlab-for-data-analytics-1525861909298.html
2. https://in.mathworks.com/products/matlab/data-analysis.html
3. https://in.mathworks.com/videos/data-analytics-with-matlab-99066.html?s_tid=vid_pers_recs

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HO 20AIH09 3D Graphics and Animation   4   0   0   4

At the end of the course, students will be able to

Code	Course Outcomes
20AIH09.1	Design three-dimensional graphics
20AIH09.2	Apply three dimensional transformations
20AIH09.3	Design animation sequences
20AIH09.4	Explain the computer graphics realism
20AIH09.5	State the applications of animation

Unit 1: Introduction to 3D Graphics   **12 Hours**
Three dimensional Concepts, Three Dimensional Object Representations – Polygon Surfaces- Polygon Tables- Plane Equations - Polygon Meshes, Curved Lines and Surfaces, Quadratic Surfaces, Blobby Objects

Unit 2: 3D Transformation and Viewing   **12 Hours**
Three Dimensional Geometric and Modeling Transformations – Translation, Rotation, Scaling, Composite Transformations; Three-Dimensional Viewing – Viewing Pipeline, Viewing Coordinates, Projections, Clipping; Visible Surface Detection Methods

Unit 3: Animation   **12 Hours**
Design of Animation Sequence – Animation Function – Raster Animation – Key Frame Systems – Motion Specification – Morphing– Tweening – Types of Animation – Fractals – Tools for Animation Creation

Unit 4: Animations and Realism
12 Hours Tiling the plane – Recursively Defined Curves – Koch curves – C curves – Dragons – Space filling Curves – fractals – Grammar Based Models – Fractals – Turtle Graphics – Ray Tracing

Unit 5: Applications of Animation   **12 Hours**
3D Computer Animation for Applications Such as Games and Virtual Environments – Character Animation Techniques Such As Synthesizing their Body Movements – Facial Expressions and Skin Movements – Behaviors in Crowded Scenes.

Text Books
1. Donald Hearn and Pauline Baker M, ―Computer Graphics", Prentice Hall, New Delhi, 2007
2. F.S. Hill, Jr., Stephen M. Kelley, Jr., "Computer graphics using OpenGL", Pearson Prentice Hall, Third Edition, 2007

Reference Books
1. Alan Watt, "3D Computer Graphics", Third Edition, Pearson Addison Wesley,2000
2. Alan Watt, Mark Watt, "Advanced Animation and Rendering Techniques: Theory and Practice", Addison Wesley, 1992.

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| HO | **20CSH10 Distributed and Parallel Computing** | **4** | **0** | **0** | **4** |

At the end of the course, students will be able to

Code	Course Outcomes
20CSH10.1	Design and implement distributed computing systems and asses models for distributed systems.
20CSH10.2	Design and implement distributed algorithms and experiment with mechanisms such as client/server and P2P algorithms, remote procedure calls (RPC/RMI), and consistency.
20CSH10.3	Analyze the requirements for programming parallel systems and critically evaluate the strengths and weaknesses of parallel programming models.
20CSH10.4	Differentiate between the major classes of parallel processing systems.
20CSH10.5	Analyze the efficiency of a parallel processing system and evaluate the types of application for which parallel programming is useful.

Unit I: Parallel Computing   12 Hours
Motivation, Key Concepts and Challenges, Overview of Parallel computing, Flynn's Taxonomy, Multi-Core Processors Shared vs. Distributed memory, Parallel Architectures: Introduction to Open Programming, Instruction Level Support for Parallel Programming, SIMD, Vector Processing, GPUs.

Unit II: Distributed Parallel Algorithm Design   12 Hours
Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load balancing, Parallel Algorithm Models. Distributed system: Introduction, Characterization of Distributed Systems, Distributed Shared Memory, Message Passing, Programming Using the Message Passing Paradigm, Group Communication.

Unit III: Recovery & Consensus   12 Hours
Recovery Check pointing, Time and Global States, Synchronizing Physical Clocks, Logical Time and Logical Clock, Coordination and Agreement, Distributed Mutual Exclusion, Election Algorithms, Consensus and agreement algorithms: Problem definition, Overview of results, Agreement in a failure, Agreement in synchronous systems with failures.

Unit IV: Distributed Transactions   12 Hours
Transaction And Concurrency Control, Nested Transactions, Locks, Optimistic Concurrency Control, Timestamp Ordering Distributed Transactions, Flat and Nested, Atomic, Two-Phase Commit Protocol, Concurrency Control, Transaction and Concurrency Control, Nested Transactions, Locks, Optimistic Concurrency Control, Timestamp Ordering Distributed Transactions, Flat and Nested, Atomic, Two Phases Commit Protocol, Concurrency Control.

Unit V: Distributed Architecture and Variants   12 Hours
Distributed File System: Architecture, Processes, Communication Distributed Web-based System: Architecture, Processes, Communication, Overview of Distributed Computing Platforms.

Text Books

1. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, "Distributed Systems: Concepts and Design", 5th Edition, Pearson– Wesley, 2012.
2. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, "Introduction to Parallel Computing", Pearson, 2nd Edition, 2008.

Reference Books

1. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", Pearson, 2nd Edition, 2006.
2. Pradeep K. Sinha, "Distributed Operating System: Concepts and Design", PHI Learning Pvt. Ltd., 2007.

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Web Resources

1. https://www.geeksforgeeks.org/difference-between-parallel-computing-and-distributed-computing/

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HO 20DSH10 Data Preparation and Cleaning

4 0 0 4

At the end of the course, students will be able to

Code	Course Outcomes
20DSH10.1	Describe the basic concepts of Data Preparation
20DSH10.2	Identify Data Preparation Techniques
20DSH10.3	Able to Handle Messy Data
20DSH10.4	Interpret Feature Selection on different types of Data
20DSH10.5	Able to apply Data Transformation & Data Reduction Techniques

Unit I: Data Preparation Basics **12 Hours**
Introduction to Data Preparation, Choosing correct Data Preparation Techniques, Importance of Data Preparation, Preparation of Raw Data, Predictive Modeling, Real-time & Scalability Issues in Data Preparation

Unit II: Data Preparation Techniques **12 Hours**
Data Preparation Techniques, Common Data Preparation Tasks, Data Cleaning, Feature Selection, Data Transforms, Feature Engineering, Dimensionality Reduction, Data Preparation without Leakage, Problems with Naïve Data Preparation, Data Preparation with Train & Test Sets, Data Preparation with Cross-Validation

Unit III: Data Cleaning **12 Hours**
Data Cleaning Introduction, Messy Datasets, Identify & Delete Columns that contains a single value, Consider Columns that have very few values, Removing Columns that have low variance, Identify & remove rows that contain a duplicate value, Outlier Identification & Removal, Handling Missing Data, KNN Imputation

Unit IV: Feature Selection **12 Hours**
Feature Selection Introduction, Statistics for Feature Selection, Feature Selection for any Datatype, Selecting Categorical Input Features, Selecting Numerical Input Features, Selecting Features for Numerical Output

Unit V: Data Transformation& Dimensionality Reduction **12 Hours**
Scaling Numerical Data, Scaling Data with Outliers, Encoding Categorical Data, Transforming Numerical Data to Categorical Data, Problems with many Input Variables, Dimensionality Reduction, Techniques for Dimensionality Reduction, PCA Dimensionality Reduction

Text Books

1. Jason Brownlee, "Data Preparation for Machine Learning- Data Cleaning, Feature Selection & Data Transforms in Python", Edition v1.1, Machine Learning Mastery Publications, 2020

Reference Books

1. Tamraparni Dasu, Theodore Johnson, "Exploratory Data Mining & Data Cleaning", Edition 1, Wiley Publications, 2003.

Web Resources

1. https://www.techtarget.com/searchbusinessanalytics/definition/data-preparation
2. https://www.techtarget.com/searchdatamanagement/definition/data-scrubbing

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HO 20AIH12 Augmented Reality and Virtual Reality   4   0   0   4

At the end of the course, students will be able to

Code	Course Outcomes
20AIH12.1	Demonstrate the concepts of augmented reality
20AIH12.2	Identify augmented reality contents and interactions
20AIH12.3	Explain the components of virtual reality
20AIH12.4	Explain the modeling tools of virtual reality
20AIH12.5	State the applications of virtual and augmented reality

Unit 1: Introduction to Augmented Reality   **12 Hours**
Introduction, The Relationship Between Augmented Reality and Other Technologies-Media, Applications of Augmented Reality Augmented Reality, Ingredients of an Augmented Reality Experience

Unit 2: Augmented Reality Content and Interaction   **12 Hours**
Content – Creating visual content – 3D Objects – 2D images – Visual elements, Interaction in Augmented Reality –Interaction in Real World – Manipulation – Navigation –Multi Person Augmented Reality Application

Unit 3: Introduction to Virtual reality   **12 Hours**
The three I's of virtual reality - Commercial VR technology and the Five Classic Components of a VR System - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional Position Trackers, Navigation and Manipulation-Interfaces and Gesture interfaces -Output Devices: Graphics Displays-Sound Displays & Haptic feedback.

Unit 4: VR Development Process   **12 Hours**
Geometric Modeling - Kinematics Modeling- Physical Modeling - Behavior Modeling - Model Management.

Unit 5: Applications   **12 Hours**
Medical applications-Military Applications - Robotics Applications- Advanced Real Time Tracking- Other applications- Games, Movies, Simulations, Therapy

Text Books
1. C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008
2. Jason Jerald, The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA., 2015

Reference Books
1. Dieter Schmalstieg & Tobias Hollerer, Augmented Reality: Principles and Practice (Usability) by Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.
2. Steve Aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability), Addison-Wesley Professional; 1 edition, 2016.

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MI 20CEM01 Air Pollution

3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20CEM01.1	Identify different types of pollution and their sources
20CEM01.2	Identify the meteorological components
20CEM01.3	Outline the impact on local and global effects of air pollution on human, materials, properties and vegetation
20CEM01.4	Explain various types of air pollution control equipment and their working principles
20CEM01.5	Understand sampling methods and monitoring of air pollution

Unit I: Introduction
9 Hours

Definition of air pollution, Sources and causes of air pollution, Types and classification of air pollution - Natural contaminants, Particulate, Gases and Vapors, Primary and secondary air pollutants

Unit II: Meteorology
9 Hours

General atmospheric circulation, Atmospheric stability, Effect of meteorology on Plume dispersion, Inversion, Wind profiles and stack plume patterns

Unit III: Effects of Air Pollution
9 Hours

Effects of air pollution on human beings, plants and animals and properties. Global effects-Green house effect, Ozone depletion, heat island, dust storms, Automobile pollution sources and control, Photochemical smog

Unit IV: Air Pollution Control
9 Hours

Particulate matter and gaseous pollutants - Settling chambers, Cyclone separators, Scrubbers, Filters & Electrostatic precipitator

Unit V: Air Quality Sampling and Monitoring
9 Hours

Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants

Text Books

1. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, "Environmental Engineering", Mc Graw Hill, International Edition, 2017
2. Rao M. N., Rao H. V. N., "Air Pollution", 1ˢᵗ Edition, Mc Graw Hill, 2004

Reference Books

1. Martin, Crawford, "Air Pollution Control Theory", Tata McGraw Hill, New Delhi, 1986
2. Bulkeley, H., "Cities and Climate Change", Routledge, London, 2013
3. Rao C. S., "Environmental Pollution Control Engineering," Wiley Eastern Limited, New Delhi, 1992
4. Gurjar, B. R., Molina, L., Ojha, C. S. P., "Air Pollution: Health and Environmental Impacts", CRC Press, 2010

Web References

1. http://www.epa.gov
2. http://www.indiaenvironmentportal.org.in
3. http://nptel.iitm.ac.in
4. http://www.filtersource.com
5. https://dgserver.dgsnd.gov

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MI   20CSM01 E-Commerce   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20CSM01.1	Explain the role of new internet economy in E-Commerce
20CSM01.2	Explain the architecture of World Wide Web
20CSM01.3	Describe the E-Commerce process models and E-Payment System
20CSM01.4	Illustrate the network models in customization and internal commerce
20CSM01.5	Explain the E-commerce models in advertising and marketing of business

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction   9 Hours
Electronic Commerce- Architectural Frame work, anatomy of E-commerce applications, E-Commerce consumer applications, E-commerce organization applications

E-Commerce and media convergence

Unit II: World Wide Web & Network security   9 Hours
Client-Server Network security, World Wide Web (WWW) as the architecture, Web background: Hypertext Publishing, Technology behind the web, Security and the web,

Emerging Client-Server Security Threats

Unit III: E-Payment Systems   9 Hours
Consumer Oriented Electronic Commerce- Mercantile Process models, E-Payment systems- Digital Token-Based, smart cards, credit cards, risk and E- Payment systems

Designing E-Payment Systems

Unit IV: EDI Implementation and Intra organizational E-Commerce   9 Hours
Standardization and EDI, EDI Software implementation, Value added networks, Intra organizational E-Commerce- Workflow Automation and Coordination, Customization and Internal Commerce, Supply chain management (SCM).

EDI Envelope for Message Transport

Unit V: Advertising and Marketing on the Internet   9 Hours
Corporate Digital Library- Document Library, digital document types, corporate data warehouses, Advertising and marketing-Information based marketing, Advertising on Internet, online marketing process, market research.

Charting the Online Marketing Process

Text Books
1. Ravi Kalakota and Andrew B. Whinston., "Frontiers of electronic commerce", First Edition, Pearson Education , 2011
2. Jaiswal S., " E-Commerce", Second Edition,Galgotia,2010

Reference Books
1. Dave Chaffey., "E-business & E- commerece management- strategy, implementation and Practice", Fifth edition, Pearson Education, 2015.
2. Kenneth C, "E-Commerce: Business.Technology.Society", First Edition, Pearson Education, 2008

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Web References

1. https://www.techopedia.com/definition/18226/corporate-data-warehouse-cdw
2. http://ecmrce.blogspot.com
3. http://data.conferenceworld.in

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Write any four important E-Commerce organization Applications
2. Write about any four requirements of EDI
3. Write short notes on Risks in E-Payment systems
4. Write short notes on Market research
5. What are the factors for design of electronic payment system?

L2: Understand

1. How enterprise resource planning and supply chain management software differs in their goals and implementations
2. How product or service customization is adopted in intraorganizational commerce?
3. Explain Merchantile's model from the Merchant's perceptive
4. Explain in detail about E-Payment systems
5. Discuss about mercantile transaction using credit cards

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20MEM01 Biomaterials

| | | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes
20MEM01.1	Classify various biomaterials
20MEM01.2	Identify the Metallic implant materials
20MEM01.3	Describe the failure modes of implant materials
20MEM01.4	Apply Ceramic implant materials
20MEM01.5	Develop the Biocompatibility & Toxicological properties in of biomaterials

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

Unit I: Introduction
09 Hours

Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra- vascular system). Surface properties of materials.

physical properties of materials, mechanical properties.

Unit II: Metallic implant materials
09 Hours

Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking. Host tissue reaction with bio metal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants.

Vascular implants, Heart valve implants-Tailor made composite in medium.

Unit III: Polymeric implant materials
09 Hours

Polyolefin's, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetyls. (Classification according to thermo sets, thermoplastics and elastomers).Viscoelastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity. Importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives (processing aids), aging and environmental stress cracking. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems.

Synthetic polymeric membranes and their biological applications.

Unit IV: Ceramic implant materials
09 Hours

Definition of bio ceramics. Common types of bio-ceramics: Aluminum oxides, Glass ceramics, Carbons. Bio resorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction). Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement

(short and long fibers, fibers pull out).

Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

Unit V: Biocompatibility & Toxicological screening of biomaterials
09 Hours

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situimplantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization.

carcinogenicity, mutagenicity and special tests.

Text Books

1. Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et. al. AcademicPress, San Diego, 1996.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. J B Park, Biomaterials – Science and Engineering, Plenum Press, 1984.
4. Comprehensive structural interity, Vol.9: Bioengineering Editors: Mithe, Ritchie and Karihalo, ElsevierAcademic Press, 2003.

Reference books

1. Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoet and Lemons, Second Edition: Elsevier Academic Press, 2004.

Web References

1. https://nptel.ac.in/content/syllabus_pdf/113104009.pdf
2. RBM603 BIOMATERIALS Syllabus free download
3. UP Technical University BE BM Syllabus
4. RBM603 Syllabus, BM Unit-wise Syllabus – BE 6th Semester

Internal Assessment Pattern

CognitiveLevel	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	10	10
L2	30	30
L3	60	60
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels
L1: Remember

1. Write about classification of biomaterials?
2. State the applications of biomaterials?
3. List the advantages and disadvantages biomaterials?
4. Write about Effects of physiological fluid on the properties of biomaterials?
5. Define Importance of stress-corrosion cracking?

L2: Understand

1. Surface properties of materials
2. Comparison of properties of some common biomaterials
3. Corrosion behavior and the importance of passive films for tissue adhesion
4. Visco elastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity

L3: Apply

1. Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions

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20EEM01 Basic Control Systems   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20EEM01.1	Determine time response specifications of second order systems
20EEM01.2	Determine error Constants for different types of input signals
20EEM01.3	Understand various levels of illuminosity produced by different illuminating sources.
20EEM01.4	Design different lighting systems by taking inputs and constraints in view for different layouts.
20EEM01.5	Understand the speed/time characteristics of different types of traction motors.

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction to Control Systems   09 Hours

Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, transfer function of linear system, differential equations of electrical networks, translational and rotational mechanical systems

Differences between Closed loop and Open Loop Control Systems

Unit II: Time Response Analysis   09 Hours

Standard test signals time response of first and second order systems time domain specifications, steady state errors and error constants

Definitions of Time domain Specifications

Unit III: Stability   09 Hours

The concept of stability, Routh's stability criteria – Limitations of Routh's stability, effect of addition of poles and zeros, introduction to root locus.

Basics of Routh's Criteria

Unit IV: Frequency response   09 Hours

Introduction to frequency domain specifications, basics of bode plot, Phase margin, Gain Margin. Introduction to Polar plots, its phase margin and gain margin. Introduction to Nyquist stability criteria

Definitions of Frequency domain Specifications

Unit V: State Space Analysis   09 Hours

Concepts of state, state variables and state model, state space representation of transfer function, diagonalization, solving the time invariant state equations, State Transition Matrix and its Properties, concepts of controllability and observability.

Basics of Matrix operations

Text Books

1. I.J.Nagarath and M.Gopal, "Control Systems Engineering", Newage International Publications, 5th Edition, 2014.
2. Kotsuhiko Ogata, Modern Control Engineering, Prentice Hall of India, 5th edition, 2014

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Reference Books

1. S.Palani, "Control Systems Engineering", Tata Mc Graw Hill Publications, 3rd Edition, 2012.

Web References

1. https://nptel.ac.in/courses/107/106/107106081/
2. https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	30	30
L2	40	30
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels
L1: Remember

1. What are the various standard test signals?
2. Define concept of observability.
3. What is state transition matrix? Write its properties.

L2: Understand

1. Explain how Routh Hurwitz criterion can be used to determine the absolute stability of a system
2. Explain about feedback characteristics.
3. Describe the effect of addition of poles and zeros.

L3: Apply

1. The characteristic polynomial of a system is.$s5+2s6+3s5+s4+5s3+2s2+s+7=0$. Determine the the stability of the system using Routh's stability criteria.
2. Determine range of K for stability of unit feedback system whose open loop transfer function is $G(s) = K/s(s+1)(s+2)$.
3. For a system having $G(s) = 25/s(s+10)$ and units negative feedback, find its time response specifications.

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20ECM01 Semiconductor Devices & Circuits
| | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes
20ECM01.1	Classify different types of semiconductors with energy band diagrams
20ECM01.2	Explain the operation and characteristics of PN junction diode and special diodes
20ECM01.3	Classify and Analyze different types of rectifiers
20ECM01.4	Demonstrate the flow of current in different configurations of the transistor & the concept of DC biasing and transistor stabilization
20ECM01.5	Analyze and Design the small signal low frequency amplifiers

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Semiconductor Physics
09 Hours

Atomic structure, Neil Bohr's atomic theory, definition of conductors, insulators and semiconductors, energy level diagrams. Semiconductors: Classification and types, intrinsic and extrinsic, P-type and N-type semiconductors, majority and minority carriers, recombination, effect of temperature.

Fermi Level, Charge Densities in Semiconductors

Unit II: Semiconductor Diodes and Special Diodes
09 Hours

Formation of depletion region, barrier potential, reverse breakdowns, PN junction as diode, symbol, biasing modes, V-I characteristics, diode current equation, effect of temperature on diode current, ideal diode. Special Diodes: Zener diode, Photo Diode, LED - Working, characteristics and applications.

Diode Switching times, Varactor diode, Tunnel Diode

Unit III: Rectifiers and Filters
09 Hours

Half wave Rectifier, Full wave rectifier, Bridge Rectifier - Operation, Input and output wave forms. Filters: Inductor filter, Capacitor filter, π filter, Comparison of various filter circuits in terms of ripple factors.

LC filter, Multi section π filter

Unit IV: Transistors and Biasing Techniques
09 Hours

Junction transistor, Transistor current components, Transistor configurations, Transistor as an amplifier, characteristics of transistor in CB and CE configurations. Need for biasing, operating point, Load line analysis, fixed bias and self bias, Stabilization against variations in V_{BE}, I_c, and β, Stability factor, Thermistor and Sensistor bias compensation techniques, Thermal runaway.

Ebers-Moll model of a transistor, Punch through/reach through, Thermal stability

Unit V: Small Signal Low Frequency Transistor Amplifier Models
09 Hours

BJT: Two port network, Transistor hybrid model, Determination of h-parameters, Generalized analysis of transistor amplifier model using h-parameters, Exact and approximate analysis of CB and CE amplifiers, Comparison of transistor amplifiers.

Effects of emitter bypass capacitor (Ce) on low frequency response

Textbooks

1. Lal Kishore K., "Electronic Devices and Circuits", 4th Edition, Bright Sky Publications, 2016
2. Millman J. and Christos C. Halkias, "Electronic Devices and Circuits", 4th Edition, Tata Mc-Graw Hill, 2010
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2009
4. Boylestad R. L. and Louis Nashelsky, "Electronic Devices and Circuits", 10th Edition, Pearson Publications, 2009

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Reference Books

1. Salivahanan S., Suresh Kumar and Vallavaraj N. A., "Electronic Devices and Circuits", 2nd Edition, Tata Mc-Graw Hill, 2012
2. Donald A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010
3. Millman J. and Halkias C., "Integrated Electronics", 2nd Edition, Tata Mc-Graw Hill, 2009
4. Singh B. P. and Rekha, "Electronic Devices and Integrated Circuits", 3rd Edition, Pearson publications, 2009
5. Mittal G. K., "Electronic Devices and Circuits", 3rd Edition, Khannan Publishers, 2008

Web Resources

1. www.elprocus.com/p-n-junction-diode-theory-and-working/
2. http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html
3. http://nptel.ac.in/courses/117103063/11

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	35
L2	40	35
L3	20	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Semiconductor
2. What is ideal diode?
3. List any three applications of Zener diode
4. What is rectifier?
5. Define ripple factor
6. What is BJT?
7. What is thermal runaway?
8. Define stability

L2: Understand

1. Describe the formation of P type semiconductor
2. Draw and explain V-I characteristics of PN junction diode
3. Describe the construction and operation of Photo diode
4. With neat circuit diagram describe the operation of bridge rectifier
5. Explain, why Zener diode is used in reverse bias with the help of characteristics
6. Draw and explain the input and output Characteristics of Common base configuration
7. With neat sketches explain the V-I characteristics of NPN transistor in common emitter configuration
8. Write a short note on Thermal Runaway
9. Explain thermister compensation technique

L3: Apply

1. Show that the efficiency of half wave rectifier is 40.6%
2. Show that the efficiency of full wave rectifier is 81.2%
3. Obtain an expression of stability factor for fixed bias
4. With suitable expressions explain self bias of BJT
5. Obtain the expressions for voltage gain and current gain of small signal low frequency common emitter amplifier

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MI 20AIM01 Fundamentals of Neural Networks   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20AIM01.1	Describe the concepts of artificial neural networks
20AIM01.2	Compare functions of biological and artificial neural networks
20AIM01.3	Explain the architecture and functioning of Single Layer feed forward networks
20AIM01.4	Describe architecture and functioning of Multi-layer networks
20AIM01.5	Explain associative memory networks
L1: Remember	L2: Understand	L3: Apply	L4: Analyze	L5: Evaluate	L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to Neural Networks   9 hours
Introduction - Humans and Computers - Organization of the Brain – Biological Neuron - Biological and Artificial Neuron Models - Characteristics of ANN - McCulloch-Pitts Model - Historical Developments - Potential Applications of ANN

Unit 2: Essentials of ANN   9 hours
Artificial Neuron Model - Operations of Artificial Neuron - Types of Neuron Activation Function - ANN Architectures - Classification Taxonomy of ANN – Connectivity - Learning Strategy (Supervised, Unsupervised, Reinforcement) - Learning Rules

Unit 3: Single Layer Feedforward Networks   9 hours
Introduction - Perceptron Models: Discrete - Continuous and Multi-Category - Training Algorithms: Discrete and ContinuousPerceptron Networks – Limitations of the Perceptron Model

Unit 4: Multi - Layer Feedforward Networks   9 hours
Generalized Delta Rule - Derivation of Backpropagation (BP) Training - Summary of Backpropagation Algorithm - Kolmogorov Theorem, Learning Difficulties and Improvements

Unit 5: Associative Memory Networks   9 hours
Paradigms of Associative Memory - Pattern Mathematics - Hebbian Learning - General Concepts of Associative Memory - Bidirectional Associative Memory (BAM) Architecture - BAM Training Algorithms: Storage and Recall Algorithm - BAM Energy Function

Text Books
1. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks Using MATLAB 6.0", Tata McGraw-HillCompanies, 2006
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Second Edition, Pearson Education, Asia
3. James A. Freeman, David M. Skapura, "Neural Networks: Algorithms, Applications, and Programming Techniques", Addison-Wesley Publishing Company

Reference Books
1. B. YagnaNarayana, "Artificial Neural Networks", Prentice Hall India, 2013
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.
3. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education

Web Resources
1. https://www.tutorialspoint.com/artificial_neural_network/index.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1	Internal Assessment #2
L1	50	50
L2	50	50
Total (%)	100	100

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Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember
5. Define Neural Computing
6. Define ANN and Neural Computing
7. List any 4 design parameters in the design of Artificial Neural Network
8. What kinds of transfer functions can be used in each layer?
9. Define Pattern Association
10. What is Adaline Model?
11. What are the types of Learning?
12. What is simple artificial neuron?
13. List any 4 applications of Artificial Neural Network
14. Define Delta Learning rule

L2: Understand
4. Describe on the process of assigning and updating weights in a artificial neural network
5. What are the design steps to be followed for using ANN for your problem?
6. Describe least square algorithm with example
7. Why XOR Problem cannot be solved by a single layer perceptron? Write an alternative solution for it
8. Explain Back Propagation Network with necessary diagrams and equations
9. Write the differences between Hetero Associative Memories and Interpolative Associative Memories

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20DSO03 Introduction to R Programming   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20DSO03.1	Understand the basic concepts of R programming
20DSO03.2	Understand about Scalars and Vectors
20DSO03.3	Implement Lists and data Frames
20DSO03.4	Implement Tables and Statistical Distributions
20DSO03.5	Implement Functions in R programming

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction   9 Hours

Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

Variable Scope & Default Arguments

Unit II: Control Structures And Vectors   9 Hours

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes
Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

Higher-Dimensional Arrays

Unit III: Lists   9 Hours

Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations

Merging Data Frames

Unit IV: Factors and Tables   9 Hours

Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Lik Operations on Tables, Extracting a Sub table, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

aggregate () Function, Set Operations

Unit V: Functions   9 Hours

Scripts to Functions, Making the Script, Transforming the Script, Using the Function, Reduce the number of Lines, Adding more Arguments, Dots, Using Functions as Arguments, Crossing the Boarders, Choices with If-Else Statements, vectorizing Choices, Looping Through Values

Coping and Scoping of Functions

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Text Books

1. Norman Matloff, " The Art of R Programming- A Tour of Statistical Software Design ", 2011
2. Roger D. Peng, " R Programming for Data Science ", 2012

Reference Books

1. Garrett Grolemund, Hadley Wickham, "Hands-On Programming with R: Write Your Own Functions andSimulations", 1st Edition, 2014
2. Andrie de Vries, Joris Meys, "R For Dummies", 2nd Edition, 2015

Web References

1. https://swayam.gov.in/nd1_noc19_ma33/preview
2. https://data-flair.training/blogs/object-oriented-programming-in-r/
3. http://www.r-tutor.com/elementary-statistics
4. https://www.tutorialspoint.com/r/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Write about vectors in R
2. Write any three type conversions in R
3. What is a data structure in R?
4. Write any two Boolean operators in R
5. Write any two linear vector algebra operations
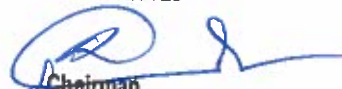
L2: Understand

1. Explain the importance of data frame
2. How to apply same functions to all rows and columns of a matrix? Explain with example
3. Explain about Finding Stationary Distributions of Markov Chains
4. Describe R functions for Reading a Matrix or Data Frame from a File
5. Explain different matrix operation function in R

L3: Apply

1. Implement binary search tree with R
2. Write R script to create a line graph
3. Create a R language code to generate first n terms of a Fibonacci series
4. Apply R program to implement quicksort
5. Apply R code to the function by using if else
   commandf(x) = x if x<1/2
   = (1-x) if 1/2<x<1
   = 0 otherwise

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MI 20SHM01 Psychology

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20SHM01.1	Focuses on classical/operant conditioning, reinforcement schedules, and observational learning to help students obtain an understanding of learning and conditioning
20SHM01.2	Understand the properties of Senses
20SHM01.3	Understand the state of Consciouness, Sleep & Dreams
20SHM01.4	Understand the importance of learning
20SHM01.5	Understanding the components of memory, language, cognition, problem solving, and the many forms of memory will be the focus of this course

Unit I: Introduction
9 Hours

Definition of Psychology, Psychology as a Science: Methods of psychology, Different schools of Psychology and modern perspectives of psychology - Scope and branches of psychology

Unit II: Sensation and Perception
9 Hours

General Properties of Senses, subliminal stimuli, Selective Attention, Physiological correlates of Attention, Internal influences on Perception - Learning, Set, Motivation and Emotion, External influences on perception - Figure Ground separation, Movement, organization, illusions, Perceptual constancies, Depth perception, Binocular and Monocular Depth, Perception; Perceptual defense and perceptual vigilance, sensory deprivation, sensory bombardment

Unit III: Consciousness
9 Hours

Fundamental Process, Active and passive roles of consciousness, Sleep and Dreams, Meditation, Hypnosis, Psi Phenomena, Alternate states of consciousness, Natural and Drug induced

Unit IV: Learning
9 Hours

Definition of learning, Theories of learning, Classical conditioning, Operant conditioning, Cognitive Learning, Social Learning

Unit V: Memory
9 Hours

Meaning and nature of memory, Theories of memory: Information processing theories - sensory register, short term memory, rehearsal; Levels of processing theories, Long term memory - organizations, TOT, semantic and episodic memory, encoding and storing long term memories, role of organization, role of imagery, role of constructive processes; Retrieval from long term memory, Forgetting- Motivated forgetting, Interference, Decay through disuse, Techniques of improving memory

Text Books

1. Morgan C. T., King, R. A., Weisz, J. R. and Schopler J., Introduction to Psychology, 7ᵗʰ Edition, Singapore: Mcgraw - Hill, 2007
2. Myers D. G., Psychology, 5ᵗʰ Edition, Worth Publishers: New York, 2004
3. Kalat J., Introduction to Psychology, 8ᵗʰ Edition, Wordsworth Pub. Co., 2007

Reference Books

1. Feldman R. S., Understanding Psychology, 6ᵗʰ Edition, Tata McGraw - Hill, New Delhi, 2006
2. Kosslyn S. M. and Rosenberg R. S., Psychology in Context, 3ʳᵈ Edition, Pearson Education Ltd., 2006

Web References

1. https://www.all-about-psychology.com/learn-psychology.html
2. https://study-uk.britishcouncil.org/plan-studies/choosing-course/subjects/psychology
3. https://www.youtube.com/watch?v=k-P1BEk6hhE

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20SHM02 Statistical Methods   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20SHM02.1	Demonstrate statistical techniques in real life problems
20SHM02.2	Gain statistical knowledge on measures of central tendency and variation
20SHM02.3	compute sample space, event, relative frequency, probability, conditional probability, independence
20SHM02.4	familiar with some standard discrete and continuous probability distributions
20SHM02.5	Understand the theory of sampling techniques and their practical applications

Unit I: Introduction   9 Hours
Definition and classification of statistics, Stages in statistical investigation, Definition of some basic terms, Applications, uses and limitations of statistics, Scales of measurement, methods of data collection and presentation, Diagrammatic and graphical presentation of data

Unit II: Treatment of Data   9 Hours
Frequency distributions, stem-leaf displays, measures of central tendency (mean,median,mode,quantiles), measures of variation (range, quartile deviation, mean deviation, standard deviation), standard scores, moments (about origin and mean) skewness and kurtosis

Unit III: Elementary Probability   9 Hours
Introduction, definitions of random experiment, samplespace, events, types of events, countingrules, permutation and combinations rule, definition of probability in several approaches, some probability rules, conditional probability and independence, bayes theorem

Unit IV: Probability Distributions   9 Hours
Definition of random variables and probability distributions, Introduction to expectation: mean and variance of a random variable, Common discrete probability distributions: Binomial and Poisson, Common continuous probability distributions: normal, t and chi-square distributions

Unit V: Sampling Techniques   9 Hours
Basic concepts: population, sample, parameter, statistic, sampling frame, sampling units , Reasons for sampling, Sampling and non sampling errors, probability sampling techniques (simple, stratified, systematic), Non probability sampling methods

Text Books

1. Bluman A. G., Elementary Statistics: A Step by Step Approach, 2ⁿᵈ Edition, Wm. C. Brown Communications, Inc., 1995
2. Spiegel M. R. and Stephens L. J., Schaum's Outline of Statistics, Schaum's Outline Series , 4ᵗʰ Edition, 2007
3. Gupta C.B. and Gupta, V., An Introduction to Statistical Methods, Vikas Publishing House, Pvt. Ltd., India, 2004

Reference Books

1. Richard A., Gupta C. B.", Probability and Statistics for Engineers", Miller & Fruend ,Pearson's Edition, 2010
2. Freund, J. E. and Simon G. A., Modern Elementary Statistics, 9ᵗʰ Edition, 1998
3. Snedecor G.W. and Cochran W. G.,Statistical Methods, 7ᵗʰ Edition, 1980
4. David S. M., McCabe P. and Craig B., Introduction to the Practice of Statistics, 6ᵗʰ Edition, W. H. Freeman, 2008

Web References

1. https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2. https://archive.nptel.ac.in/courses/111/105/111105077/
3. http://www.nitttrc.edu.in/nptel/courses/video/111105077/L10.html

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20MBM01 General Management	3	0	0	3

At the end of the course, students will be able to

Code	Course Outcomes
20MBM01.1	Understand basic functions of management
20MBM01.2	Understand the planning process and strategic formulation
20MBM01.3	Know the nature of the organization process
20MBM01.4	Understand the staffing objectives and functions
20MBM01.5	Understand the directing process and controlling methods

Unit I: Management Introduction 09 Hours

Concept, Nature, Process and Significance of Management, Managerial Roles (Mintzberg), An Overview of Functional areas of Management - Marketing, Finance, Production, HRM, IT,R & D, Development of Management Thought - Classical, Neo – classical

Unit II: Planning 09 Hours

Process and Types, Decision - making concept and process, Bounded rationality, Management by objectives, Corporate Planning - Environment analysis and Diagnosis, Strategy Formulations

Unit III: Organizing 09 Hours

Concept, Nature, Process and Significance, Authority and Responsibility relationships - Delegation, Decentralisation, Departmentation basis and formats (Project and Matrix), Formal and Informal Organisation, Changing patterns in organisation structures in the knowledge economy

Unit IV: Staffing 09 Hours

Human Resource Planning, Objectives, Factors influencing Human Resource Planning, HR Planning Process, Job Analysis, Recruitment, Process and Sources of Recruitment, Selection, Process of selection and Techniques, Errors in selection Retention of employees

Unit V: Directing and Control 09 Hours

Motivating and Leading People at work - basic concepts, Communication - nature, process, networks and barriers, Effective Communication Managerial Control - Concept and process, Designing an Effective Control System, Techniques –Traditional and Modern (PERT and CPM)

Note: Discuss case studies from every unit

Text Books

1. Singh B. P. and Chhabra T. N., Management Concepts and Practices, Dhanpat Rai, New Delhi
2. Singh B. P. and Singh A. K., Essentials of Management, Excel Books, New Delhi
3. Dwivedi R. S. Management – An Integrated Approach, National Publishing House

Reference Books

1. Weihrich, Heing and Harold Koontz, Management a Global Perspective, Mc - Graw Hill, New Delhi
2. Stoner, James A. F., Freeman A. E. and Gilbert D. A., (Jr.), Management, Prentice Hall of India Pvt. Ltd.
3. Ivancevich, John M., Donnelly J. H. and Gibson J. L., Management: Principles and Functions, AITBS, New Delhi
4. Luthans, Fred, Introduction to Management, Mc - Graw Hill
5. Jones, Gareth R and Jennifer M., George, Contemporary Management, Tata Mc-Graw Hill

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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MI 20MBM02 Human Resource Planning   3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20MBM02.1	Understand staffing concept Write sound job descriptions, job specifications
20MBM02.2	Develop a structured, job - related interview for talent acquisition across all the verticals
20MBM02.3	Know the training and development strategies of a firm
20MBM02.4	Understand compensation management and performance management process
20MBM02.5	Understand the role of trade unions in a firm

Unit I: Introduction   09 Hours
Human resource planning concepts, Concept of Staffing, Factors affecting Staffing, Staffing Process. Job Analysis -- Concept, Job - Specifications, Job - Description, Process and Methods, Advantages of Job Analysis. Job Designing: Introduction, Definition, Modern Techniques, Factors affecting Job Design

Unit II: Talent Acquisition   09 Hours
Recruitment and Selection: Needs-recruitment process - alternative to recruitment, Concept of Selection, Criteria for Selection, Process. Screening – Pre and Post Criteria for Selection, Interviewing – Types and Guidelines for Interviewer & Interviewee, Types of Selection Tests, Selection Hurdles and Ways to Overcome Them, Current trends in Recruitment and Selection

Unit III: Training & Development   09 Hours
Induction – Concept, Types - Formal/Informal Induction, Advantages of Induction, Training Vs Development, Need, Process of Training, Methods of Training, Development techniques, need for development, Career Planning, training and development policies, linking training and development to company's strategy

Unit IV: Compensation and Performance Management   09 Hours
Compensation management process, Forms of pay, Financial and non – financial compensation - Factors influencing Wage fixation, Performance Appraisal System, Methods of Performance Appraisal, Performance management process

Unit V: Managing Industrial relations   09 Hours
Managing Industrial Relations – Components of IR - Trade Unions, Functions of Trade Union – Employee Participation – Importance and Schemes, Collective Bargaining – Grievance Redressal, Industrial Dispute – Settlement mechanism

Note: Discuss case studies from every unit

Text Books
1. Subba Rao P., Human Resource Management, Himalaya, Mumbai
2. Aswathappa K., Human Resources and Personnel Management, Tata McGraw-Hill
3. Armstrong M., Performance Management: Key Strategies and practical Guidelines, Kogan Page, London

Reference Books
1. Gary Dessler, Human Resources Management. Pearson Publication
2. Mammoria C. B., Personnel Management
3. Recruitment and Selection: Theories and Practices, Dipak Kumar Bhattacharyya, Cengage, India

Web References
1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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MI 20CEM02 Climate Change Mitigation and Adaptation

3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20CEM02.1	Understand the concept of climate change scenarios
20CEM02.2	Outline the causes for the changes in the climate
20CEM02.3	Identify the impacts of climate change on various sectors
20CEM02.4	Adopt the methodologies in finding the changes in climate
20CEM02.5	Demonstrate the climate change adaptation and mitigation options forsecuring sustainable development

Unit I: Fundamentals of Climate Change
9 Hours

Greenhouse gases, radiative forcing potential, carbon dioxide equivalency, natural climate forcing factors, emissions sources and sinks

Unit II: Observed Changes and its Causes
9 Hours

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change –Evidences of Changes in Climate and Environment – on a Global Scale and in India.

Unit III: Impacts of Climate Change
9 Hours

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios -Projected Impacts for Different Regions- Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

Unit IV: Clean Technology and Energy
9 Hours

Clean Development Mechanism -Carbon Trading- examples of future Clean Technology -Biodiesel – Natural Compost – Eco-Friendly Plastic – Alternate Energy – Hydrogen – Biofuels -Solar Energy – Wind – Hydroelectric Power.

Unit V: Adaptation and Mitigation Responses
9 Hours

Policy, Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC, Concept framework of urban adaptation to climate change, Mitigation Efforts in India and Adaptation funding.

Text Books

1. Jan C. Van Dam, "Impacts of Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003
2. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007

Reference Books

1. Pielke, R., "Lifting the taboo on adaptation", Nature 445 (7128), 597-598, 2007
2. Bulkeley, H., "Cities and Climate Change", Routledge, London, 2013

Web References

1. IPCC Fourth Assessment Report – The AR4 Synthesis Report
2. https://www.coursera.org/learn/climate-change-mitigation
3. https://www.usc.edu.au/study/courses-and-programs/courses/course-library/ens/ens204-climate-change-mitigation-and-adaptation

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| MI | **20CSM02 Knowledge Discovery and Databases** | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes
20CSM02.1	Illustrates the basic concepts of database management system
20CSM02.2	Able to summarize mining and preprocessing of data
20CSM02.3	Outline the functionalities of data mining(characterization)
20CSM02.4	Able to explain the processes of association analysis
20CSM02.5	Illustrate the features of various clustering techniques

Unit I: Introduction to Database and Data Warehouse
9 Hours
Overview of Data, What is Database and What is Database Management Base System, Meaning of Entity, Relation, Database Design and ER diagrams, Attributes, DMBS Software's available in Market, Structured Query Language (SQL)
What is Data Warehouse, Types of Data Warehouse, On-Line Analytical Processing (OLAP)

Unit II: Data Mining Introduction
9 Hours
Introduction to Data Mining Systems, Knowledge Discovery Process, Data Mining Techniques, Issues, Data Objects and Attribute Types, Statistical Description of Data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and Discretization, Data Visualization

Unit III: Classification
9 Hours
Introduction and Basic Concepts of Classification, What is Training Data, Supervisory Learning and Unsupervisory Learning, Decision Tree Induction, Working of Decision Tree and Building a Decision Tree, Bayes' Theorem, Classification by Back Propagation

Unit IV: Association
9 Hours
What is Association Analysis, Frequent Item Set Generation, Association Rule Generation using Apriori Algorithm.

Unit V: Clustering and Outlier Analysis
9 Hours
What is Cluster Analysis, Different Types of Clusters, Partition Method – K-Means Algorithm, Hierarchical Methods – Hierarchical Cluster Algorithm, Density Based Method- DBSCAN and Outlier Analysis, What is Outlier Analysis?

Practicing Tool: SQL, Weka, Python and R

Text Books

1. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", Third Edition, TATA McGraw Hill, 2008.
2. Jiawei Han and MichelineKamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson, 2016

Reference Books

1. Alex Berson, Stephen J.Smith, —"Data Warehousing, Data Mining & OLAPII", Tata McGraw – Hill Edition, 35th Reprint 2016.
2. K.P. Soman, ShyamDiwakar and V. Ajay, — "Insight into Data Mining Theory and PracticeII", Eastern Economy Edition, Prentice Hall of India, 2006.
3. Ian H.Witten, Eibe Frank, — "Data Mining: Practical Machine Learning Tools and Techniques", Second Edition, Elsevier.

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Web Resources

1. https://www.tutorialspoint.com/
2. https://www.coursera.org/learn/

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MI 20MEM02 Micro Electromechanical Systems
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At the end of the course, students will be able to

Code	Course Outcomes
20MEM02.1	Acquire the operation of micro devices, micro systems and their applications
20MEM02.2	Ability to design the micro devices, micro systems using the MEMS fabrication process.
20MEM02.3	Acquire basic approaches for various sensor design
20MEM02.4	Acquire basic approaches for various actuator design
20MEM02.5	Gain the technical knowledge required for computer-aided design, fabrication, analysis and characterization of nano-structured materials, micro- and nano-scale devices.

Unit I: Basic Concepts
9 Hours
Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA. MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology

Unit II: Thermal Sensors and Actuators
9 Hours
Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

Unit III: Micro-Opto-Electro Mechanical Systems
9 Hours
Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement, MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe-based storage device

Unit IV: Micro Fluidic Systems
9 Hours
Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemo resistors, chemo capacitors chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluorescence detection, calorimetric spectroscopy
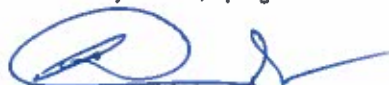
Text Books

1. Nitaigour Premchand Mahalik, "MEMS" TMH Publishing co.

Reference Books

1. Chang Liu," Foundation of MEMS", Prentice Hall Ltd.
2. Sergey EdwrdLyshevski, "MEMS and NEMS", CRC Press, Indian Edition.
3. Tai-Ran Hsu, "MEMS and Micro Systems: Design and Manufacture", TMH Publishers.
4. Thomas M Adams, "Richard A Layton Introductory MEMS", Springer International Publishers.

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Web References

1. https://nptel.ac.in/courses/117/105/117105082/

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MI 20EEM02   Basics of Electrical Machines and Drives   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20EEM02.1	Understand the basic concepts of different types of electrical drives
20EEM02.2	Able to explain the performance characteristics of electrical drives
20EEM02.3	Study the different methods of starting D.C motors and induction motors
20EEM02.4	Study the conventional and solid-state D.C. drives
20EEM02.5	Study the conventional and solid-state A.C. drives

Unit I: Introduction   9 Hours
Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

Unit II: Drive Motor Characteristics   9 Hours
Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound – single phase and three phase induction motors

Unit III: Starting Methods   9 Hours
Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors

Unit IV: Conventional and Solid-State Speed Control of D.C. Drives   9 Hours
Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system – Using controlled rectifiers and DC choppers –applications.

Unit V: Conventional and Solid-State Speed Control of A.C. Drives   9 Hours
Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme Using inverters and AC voltage regulators – applications

Textbooks

1. Nagrath I.J. & Kothari D.P, "Electrical Machines", Tata McGraw-Hill, 2006
2. Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2010

Reference Books

1. Partab. H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 2017
2. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 209
3. Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2006.

Web References

1. https://link.springer.com/book/10.1007/978-3-319-72730-1
2. https://www.routledge.com/Electrical-Machine-Drives-Fundamental-Basics-and Practice/Franchi/p/book/9781138099395

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| MI | 20ECM02 | Digital Electronics | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes
20ECM02.1	Utilize theory of Boolean algebra & the underlying features of various number systems
20ECM02.2	Choose the concepts of Boolean algebra for the minimization of switching functions
20ECM02.3	Design of various combinational logic circuits using basic gates
20ECM02.4	Design various simple programmable logic devices to complex programmable logic devices & arrays
20ECM02.5	Develop of various sequential logic circuits

Unit I: Introduction to Boolean Algebra and Switching Functions   9 Hours
Conversion from One Radix to Another Radix, r - 1 and r's complement, 4 Bit Codes: BCD, Excess - 3, 2421, 84 – 2 – 1, 9's Compliment Code, Gary Code etc. Realization of logic operations for Basic and Universal gates

Unit II: Boolean Minimization   9 Hours
Minimization of Logic Functions using Boolean Theorems, Minimization of Switching Functions using K-Map Up to 6 Variables, Quine - McCluskey Method, Standard SOP And POS forms

Unit III: Finite State Machines and Bipolar Logic Families   9 Hours
Design of synchronous FSMs, Asynchronous FSMs. Bipolar Logic Families (ECL), MOS logic families (NMOS and CMOS) and their electrical behaviour

Unit IV: Memory Elements   9 Hours
Basic structures and realization of Boolean functions using PROM, PAL, PLA, PLD, CPLD, FPGA, Buffers. Logic Implementation using Programmable Devices (ROM, PLA, FPGA)

Unit V: Elementary Combinational and Sequential Digital Circuits   9 Hours
Adders, Subtractors, Multiplexer, Demultiplexer, Encoder, Decoder, Comparators, Latches, Flip-flops, Shift registers, Counters

Text Books
1. Taub, H. and Schilling, D., "Digital Integrated Electronics", McGraw Hill, 1977
2. Hodges, D.A. and Jackson, H.G., "Analysis and Design of Digital Integrated Circuits", International Student Edition, McGraw Hill, 1983
3. Hill, F.J. and Peterson, G.L., "Switching Theory and Logic Design", John Wiley, 1981
4. Anand Kumar, A., "Switching Theory and Logic Design", 3rd Edition, Prentice Hall International Learning, 2016

Reference Books
1. Kohavi, Z., "Switching and Finite Automata Theory", McGraw Hill, 1970
2. Jain, R.P., "Modern Digital Electronics", 3rd Edition, Tata McGraw Hill, 2003
3. Charles Roth, H. and Larry Kinney, L.Jr., "Fundamentals of Logic Design", 7th Edition, Cengage Learning, 2014

Web Resources
1. https://onlinecourses.nptel.ac.in/noc19_ee51/preview
2. https://nptel.ac.in/courses/117/105/117105080/
3. https://gate.iitkgp.ac.in/gate_syllabus.html
4. https://www.ee.iitb.ac.in/web/academics/courses/EE221

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| MI | 20AIM02 | Machine Learning with Python | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes
20AIM02.1	Solve simple computational problems with python
20AIM02.2	Identify and use appropriate functions to handle data in python code
20AIM02.3	Describe the foundational concepts and terminologies of machine learning
20AIM02.4	Explain various unsupervised learning algorithms
20AIM02.5	Evaluate the performance of the machine learning algorithm

Unit 1: Basics of Python Programming
9 Hours

Introduction to Python: evolution, features – Python IDE installation – Syntax –Comments – Variables – Data types – Numbers – Strings – Booleans – Operators – Control statements – Data structures: lists, dictionary, tuples, sets, arrays – Functions

Unit 2: Python modules for ML
9 Hours

NumPy – Pandas – SciPy – Matplotlib

Unit 3: Introduction to Machine Learning
9 Hours

Machine Learning essentials: data set, mean, median, mode, standard deviation, percentile, data distribution, normal distribution – Types of learning: supervised, unsupervised – Supervised learning: classification and regression – Classification algorithms: KNN, Naïve Bayes classifier, Decision trees, Linear models, SVM

Unit 4: Unsupervised Learning and Pre-processing
9 Hours

Types of unsupervised learning – Challenges in unsupervised learning – Pre-processing and Scaling – Dimensionality reduction: Principal Component Analysis – Clustering: k-means, agglomerative, DBSCAN

Unit 5: Data Representation and Model Evaluation
9 Hours

Categorical variables: one-hot encoding – Binning – Discretization – Automatic feature selection – Model evaluation: cross-validation –Grid search – Evaluation metrics and scoring

Text Books

1. Andreas C. Miller and Sarah Guido, "Introduction to Machine Learning with Python – A guide for Data Scientist", O.Reilly Publisher, 1st edition, 2016
2. Peter Flach, "Machine Learning – The art and science of algorithms that make sense of data", Cambridge Press, 2012
3. Tom Michell, "Machine Learning", McGraw Hill, 2014

Reference Books

1. Peter Harington, "Machine Learning in Action", Cengage Publications, 2012
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012

Web Resources

1. https://www.tutorialspoint.com/python
2. https://www.w3schools/python

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| MI | **20DSM02** | **Data Management and Analysis** | **3** | **0** | **0** | **3** |

At the end of the course, students will be able to

Code	Course Outcomes
20DSM02.1	Understand database and be familiar with relational database concepts
20DSM02.2	Demonstrate knowledge of terms, methods of ER Modelling
20DSM02.3	Demonstrate knowledge of trends in data management in Entity Clustering
20DSM02.4	Demonstrate how to acquire, transform, analyse in SQL
20DSM02.5	Demonstrate how to solve problems in accounting using Transactions

Unit I: Database Concepts and Design Concepts   9 Hours
Why Databases? Data Versus Information, Why Database Design is Important? Evolution of File System Data Processing, Problems with File System Data Processing, Database Systems, Relational Database Model- A Logical View of Data, Keys, Integrity Rules, Relational Algebra, Relationships within the Relational Database, Data Redundancy

Unit II: Entity Relationship (ER) Modeling   9 Hours
Entities, Attributes, Relationships, Connectivity and Cardinality, Existence Dependence, Relationship Strength, Weak Entities, Relationship Participation, Relationship Degree, Recursive Relationships, Associative Entities, Developing an ER diagram

Unit III: Entity Clustering   9 Hours
Entity Integrity: Selecting Primary Keys, Natural Keys and Primary Keys, Primary Key guidelines, when to use Composite Primary Keys, when to use Surrogate Primary Keys, Design Cases: Learning Flexible Database Design

Unit IV: Introduction to SQL   9 Hours
Data Definition Commands, Data Manipulation Commands, SELECT Queries, Additional Data Definition Commands, Additional SELECT Query Keywords, Creating VIEW, Joining Database Tables

Unit V: Transaction Management and Concurrency Control   9 Hours
What is Transaction? Concurrency Control, Concurrency Control with Locking Methods, Concurrency Control with Time Stamping Methods, Concurrency Control with Optimistic Methods

Text Books
1. Carlos Coronel and Steven Morris," Database systems: Design, Implementation, & Management", 13th Edition. Cengage Learning. ISBN-13: 978-1337627900, 2019
2. Sholom M. Weiss, Nitin Indurkhya, Tong Zhang, and Fred Damerau, "Text Mining: Predictive Methods for Analyzing Unstructured Information", First Edition. Springer, 2020

Reference Books
1. Hector Garcia-Molina, Jeffrey D. Ullman, and Jennifer Widom, "Database Systems: The Complete Book". 2nd Edition. Pearson, 2001
2. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining: Concepts and Techniques". 3rd Edition. Elsevier. 2006

Web Resources
1. https://www.niti.gov.in/verticals/data-management-and-analysis
2. https://searchdatamanagement.techtarget.com/definition/data-management
3. https://nptel.ac.in/courses/110/104/110104094/

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20SHM03 English for the Media   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20SHM03.1	Understand what media literacy is and its importance
20SHM03.2	Introduce the essential requirements of writing for the media
20SHM03.3	Familiarise the learners with the process of writing for the media
20SHM03.4	Make them familiar with the specific use of english in the field of media
20SHM03.5	Generate interest in various aspects of media and thereby equip them with the basic writing skills required for the same

Unit I: Introduction to Media Literacy   9 Hours
Understand what media literacy is and its importance, analyze and interpret media messages through guided questions, Practice reading strategies to preview a text & skimming and scanning when you read
Practice reading for the main idea, Define and accurately use content - related vocabulary in course activities and games, Apply comprehension strategies as you read, watch, and listen to a variety of texts and multimedia sources Demonstrate your understanding of these texts and key course ideas through comprehension check quizzes and a discussion board response

Unit II: Writing for the Print Media   9 Hours
Newspaper: Writing headlines – Analysing newspaper articles- Practising interview skills – Planning and writing a newspaper article
Magazine: Composing magazine covers – Planning the contents of a magazine – Giving instructions for a photo shoot – Planning and writing a true life story

Unit III: Writing for Radio, Television and Film   9 Hours
Radio: Understanding the language of radio presenters – Understanding the production process – Planning a newslist – Giving post production feedback.
Television: Understanding the pre-production process – Organising a filming schedule – Filming on location – Editing a TV documentary
Film: Writing a screenplay – Pitching successfully – Organizing a shoot – Writing a film review

Unit IV: Writing for Advertisements   9 Hours
Advertisement : Creating a print advert –Creating a screen advert –Presenting a finished advert- Analysing market trends – Setting up a marketing communication strategy – Organising the relaunch of a product – Evaluating the success of a Relaunch

Unit V: Writing for the New Media   9 Hours
New Media: Briefing a website designer – Analysing problems and providing solutions – Planning and writing a blog – Creating a podcast- Vlogs – Graphic novel (It is suggested for students to follow the different styles of reporting in various media and to familiarize themselves with the emerging trends in the new media]
Core Reading: Ceramella, Nick and Elizabeth Lee. Cambridge English for the Media. CUP, 2008

Text Books
1. Ryan, Michael and James W Tankard, Writing for Print and Digital Media, McGraw-Hill, 2005
2. Allen, Victoria, Karl Davis et. al., Cambridge Technicals Level 3 Digital Media, Hodder, 2016
3. Hayward, Susan. Cinema studies: The Key Concepts, Routledge, 1996

Reference Books
4. Parthasarathy, Rangaswami, Here is the News! Reporting for the Media.Sterling Publications, 1998
5. Axford, Barrie and Richard Huggins. New Media and Politics, Sage, 2001

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Web References

1. https://www.google.co.in/books/edition/Designing_New_Media/
2. https://www.google.co.in/books/edition/AS_Media_Studies
3. https://www.google.co.in/books/edition/Social_Media_and_Democracy

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| MI | 20SHM04 Statistical Inference | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes
20SHM04.1	Understand the concept of sampling distribution for large and small samples
20SHM04.2	Calculate the estimator of a parameter using point estimation and bias
20SHM04.3	Compare means and variances of two independent or paired samples using interval estimation
20SHM04.4	Understand the framework of hypothesis testing for carrying out statistical inference
20SHM04.5	Carry out the NP tests with due regard to the assumptions underlying these procedures

Unit I: Sampling Distribution   9 Hours
Population, Samples, Parameter and statistics, Standard error, Sampling distribution of a statistic, Sampling distribution of mean (known and unknown variance) for large and small samples, Sampling distribution of difference of means, Central limit theorem

Unit II: Point Estimation   9 Hours
Definition of point estimator, General properties of estimators, Uniformly minimum variance unbiased estimators, Sufficient statistics, Factorization theorem, CR Rao inequality, Cramer - Rao lower bound and UMVUE, Methods of finding point estimators by MLestimation, Method of moments

Unit III: Interval Estimation   9 Hours
Notion of interval estimation, Review of sampling distributions, Confidence Intervals, Confidence interval for the mean (population variance is known and unknown), Confidence interval for the variance (population mean is known and unknown), Confidence interval for the difference between two means

Unit IV: Testing of Hypothesis   9 Hours
Statistical hypothesis, null and alternative hypothesis, Simple and composite hypotheses,Test of hypothesis, critical region, type I and type II errors and their probabilities, Simple null hypothesis versus simple alternative, Neyman - Pearson lemma, Examples from the normal population, Tests on the mean, Tests on the variance

Unit V: Non-Parametric Methods   9 Hours
Introduction, assumptions of Npmethods, Advantages and disadvantages,Testing a hypothesis about median, Test for randomness, sign test, Wilcoxon signed rank test

Text Books
1. Gupta Kapoor V. K., " Fundamentals of Mathematical Statististics", Sultan Chand Publications, New Delhi
2. Rao C. R., Linear Statistical Inference and its Applications, Wiley Eastren Publications

Reference Books
6. Richard A.,Gupta C. B. ", Probability and Statistics for Engineers", Miller & Fruend, Pearson's Edition, 2010
7. Rohatgi V. ,K. Statistical Inference, Dover Publications, 2003
8. Iyengar T. K. V., Krishna Gandhi B., Prasad M. V. S. S. N., "Probability and Statistics", Revised Edition, 2012
9. Wasserman L., "A Concise Course in Statistical Inference", Springer Publications, 2004

Web References
5. https://archive.nptel.ac.in/courses/111/105/111105043/
6. https://onlinecourses.nptel.ac.in/noc20_ma19/preview
7. https://onlinecourses.swayam2.ac.in/cec20_ma01/preview

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MI 20MBM03 Organizational Behaviour

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At the end of the course, students will be able to

Code	Course Outcomes
20MBM03.1	Understand basic concepts of organizational behavior and its nature
20MBM03.2	Understand the basic concepts personality, values and motivation
20MBM03.3	Understand inter personal behavior and its significance
20MBM03.4	Know the group behavior and its dynamics
20MBM03.5	Know about organizational climate, culture and organizational change

Unit I: Introduction
9 Hours

Organisational Behaviour - Concept and Emergence of OB Concept, Nature and Theoretical frameworks, Disciplines contributing to the field of OB, Historical Background - Hawthorne Studies, Psychological foundations

Unit II: Individual Behaviour
9 Hours

Personality, Learning, Values and Attitudes, Perception, Learning-Behaviourist, cognitive and social learning; Stress at work. Motivation -Maslow's Need Hierarchy, Herzberg's Two Factors Theory

Unit III: Inter - Personal Behaviour
9 Hours

Interpersonal communication and Feedback, Transactional Analysis (TA), Johari Window. Managingmis() behaviour at work, Substance abuse, cyber slacking, Aggression, and Violence

Unit IV: Group Behaviour
9 Hours

Group Dynamics, Cohesiveness and Productivity, Management of Dysfunctional groups, Group Decision Making, Organisational Politics.
Leadership- Concept and Styles, Fielder's Contingency Model, House's Path - Goal Theory, Leadership Effectiveness

Unit V: Organizational Process
9 Hours

Organizational Climate: Concept, Determinants, Organization Culture - Concept, Forming, Sustaining, and Changing a Culture, Organizational effectiveness - concept and measurement, Organizational change - resistance and management.

Note: Discuss case studies from every unit

Text Books

1. Singh B. P. and Chhabra T. N., Management Concepts and Practices, Dhanpat Rai, New Delhi
2. Singh B. P. and Singh A. K., Essentials of Management, Excel Books, New Delhi
3. Dwivedi R. S. Management – An Integrated Approach, National Publishing House

Reference Books

1. Udai Pareek, Organizational Behavior, 3ʳᵈ Edition, Oxford University Press, 2011
2. Subba Rao P., "Management and Organizational Behavior", 3ʳᵈ Edition, Himalaya Publishing House, 2017
3. Ghuman, K. and Aswathappa K., Management: Concepts, Practice and Cases, Tata Mc - Graw Hill

Web References

8. https://nptel.ac.in/courses/105/102/105102012/
9. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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MI | 20MBM04 Compensation Management & Employee Welfare Laws   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20MBM04.1	Understand different pay structures and pay levels
20MBM04.2	Know about wage act 1936 and its implications
20MBM04.3	Understand the factors influence the wage fixation
20MBM04.4	Understand the components of bonus act 1965
20MBM04.5	Understand various incentive plans and international compensation concept

Unit I: Compensation Management   9 Hours
Compensation management process, forms of pay, financial and non - financial compensation. Compensation Strategies, Assessing job values, pay structures, designing pay levels, construction of optimal pay structure. Paying for performance, skills and competence. International pay systems: comparing costs and systems

Unit II: The Payment of Wages Act, 1936   9 Hours
Objects, Application, Responsibility for payment of wages, Fixation of wage periods, time - limits, Deduction from wages, Remedies available to worker, Powers of authorities, Penalty for offences

Unit III: The Minimum Wages Act, 1948   9 Hours
Objects, application, minimum fair and living wages, determination of minimum wage, taxation of minimum wage, advisory board, remedy to worker for non - payment of minimum wages

Unit IV: The Payment of Bonus Act, 1965   9 Hours
Objects, Scope and Application, Definitions, Calculation ofamount payable as Bonus, Eligibility and Disqualifications for Bonus, Minimum & maximum Bonus, Application of Act in Establishment in Public Sector, Bonus linked with Production or Productivity

Unit V: Incentives Incentive Plan   9 Hours
Individual incentives, pay for performance, compensation of special group Benefits, legally required benefits: Retirement, medical and other benefits, Employee profit sharing, employee stock option, gain sharing International Compensation: Recognizing variation, the social contract, Culture and pay, Preliminary considerations of international compensation

Text Books

1. Belchor, David W., "Compensation Administration", Prentice Hall, Englewood Cliffs. NT.
2. Henderson R. I., Compensation Management in a Knowledge Based World, New Delhi: Pearson Education
3. Milkovich G., Newman J. and Ratnam C. S. V., Compensation, Tata Mc – Graw Hill, Special Indian Edition

Reference Books

1. Armstrong M.& Murlis H., Reward Management: A Hand book of Salary administration, London: Kegan Paul
2. Sharma J. P., An Easy approach to Company and Compensation Laws, New Delhi: Ane Books Pvt. Ltd.
3. Malik P. L., Hand book of Labourer and Industrial Law, Eastern Book Company
4. Government of India Report of the National Commission on Labour Ministry of Labour and Employment, New Delhi. (latest)

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1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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198

MI 20CEM03 Sustainability and Pollution Prevention Practices   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20CEM03.1	Concept of sustainability and its goals
20CEM03.2	Sources and effects of environmental pollution
20CEM03.3	Identify the prevention measures for environmental protection
20CEM03.4	Approach for analysis and assessment of developmental activities and their impacts on environment
20CEM03.5	Objectives and components of environmental management

Unit I: Concept of Sustainability and Development   9 Hours
Sustainability and its goals, Growth and development, Development and environment, Causes for industrialization, Changing life styles, Regulatory aspects of industrialization, Overall impact of industrialization and Urbanization on quality of human life, Global environmental issues

Unit II: Pollution, Monitoring and Control   9 Hours
Definition, types and sources of pollution, Quality standards for air, water, soil; types of pollutants; Methods of monitoring and control of air, water, soil Pollution (Physicochemical and bacteriological sampling and analysis); effects of pollution on plants, animals and Human beings.

Unit III: Measures for Environmental Protection   9 Hours
Formal and informal environmental education, awareness for nature conservation and protection, environmental ethics and morality, conservation of natural habitats, National parks and wild life sanctuaries, role of youth and women, role of NGO's, urban planning and land-use pattern

Unit IV: Environmental Impact Assessment   9 Hours
Definition, significance and scope of impact assessment, Need & objective, types of environmental impacts, methods of environmental impacts, major steps in impact assessment procedure, generalised approach to impact analysis

Unit V : Environmental Management   9 Hours
Objectives and components of environmental management need for training, Environmental Impact Statement and Environment Managemental Plan, Role of remote sensing in environmental management, Sustainable use of natural resources, management of soil, wildlife and its methods, agriculture management, Public participation in resource management

Text Books

1. Lars F. Niklasson, "Improving the Sustainable Development Goals: Strategies and the Governance Challenge", 2009
2. Herman Koren, "Best Practices for Environmental Health: Environmental Pollution, Protection, Quality and Sustainability", 21 April, 2017
3. McCully, P, "Rivers no more: the environmental effects of dams (pp. 29-64)", Zed Books, 1996
4. McNeill, John R, "Something New Under the Sun: An Environmental History of the Twentieth Century", 2000

Reference Books

1. Environmental Chemistry - A.K. De, New Age Int. Pub. Co., New Delhi, 1990
2. Lave, L.B and Upton, "Toxic Chemicals, Health and the Environment", The Hopkins Press Ltd., London, 1987
3. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. "Environmental and Pollution Science. Academic Press", 2011

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1. http://mcic.ca
2. https://www.drishtiias.com
3. https://www.jica.go.jp

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| MI | 20CSM03 Database Security | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes
20CSM03.1	Explain the Cossets DBMS
20CSM03.2	Explain the Constrains in Database
20CSM03.3	Describe different Database Schemas
20CSM03.4	Illustrate Desecrate Data Models and Water Marking Processes
20CSM03.5	Explains Geospatial Data Models and Access Methods

Unit I: Database Introduction
9 Hours

Introduction to Database – Relational Database & Management System, Data Abstraction (Physical Level, Logical Level & View Level) - Multi-level Database, Distributed Database, Database Architecture.

Unit II: Database Securities
9 Hours

Security issues in Database – Integrity constraints, Access Control (Grant & Revoke Privileges) - Statistical Database, Differential Privacy. Distributed Database Security.

Unit III: Schema Models
9 Hours

Security in Data Warehouse & OLAP – Introduction, Fact table, Dimensions, Star Schema, Snowflake Schema, Multi-Dimension Range Query, Data Cubes.

Unit IV: Data Mining Introduction
9 Hours

Data Mining – Introduction - Randomization methods, Data Swapping, Database Watermarking – Basic Watermarking Process - Discrete Data, Multimedia, and Relational Data, Different Data Migration Techniques.

Unit V: Geospatial Database
9 Hours

Geospatial Database Security – Geospatial data models – Geospatial Authorization, Access Control Models: Geo-RBAC, Geo-LBAC

Text Books

1. Michael Gertz., Sushil Jajodia., "Handbook of Database Security: Applications and Trends", ISBN-10: 0387485325, Springer, 2007
2. Osama S. Faragallah., El-Sayed M. El-Rabaie., Fathi E. Abd El-Samie., Ahmed I. Sallam., Hala S. El-Sayed., "Multilevel Security for Relational Databases", ISBN 978-1-4822- 0539-8, CRC Press, 2014.

Reference Books

1. Bhavani Thuraisingham., "Database and Applications Security: Integrating Information Security and Data Management", CRC Press, Taylor & Francis Group, 2005.
2. Elmasri Navrate., "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016.
3. Peter Rob., Carlos Coronel., "Database Systems Design, Implementation and Management," Tenth Edition, Pearson Education, 2013

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Web Resources

1. http://www.nptelvideos.in/2012/11/database-managementsystem.html
2. https://www.ibm.com/in-en/cloud/learn/database-security
3. http://data.conferenceworld.in

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M1 20MEM03 Surface Engineering   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20MEM03.1	Decide the surface preparation methods suitable for different substrate materials.
20MEM03.2	Apply knowledge on properties offered by different Coatings based on the application requirement.
20MEM03.3	Interpret the testing &evaluation of metallic coatings.
20MEM03.4	Explain the effect of process parameters on the properties & microstructure of the surface coating processes.
20MEM03.5	Explain the importance & role of surface modifications to achieve several technological properties.

Unit I: Fundamentals of Surface Engineering   9 Hours
Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc., Coatings: Classification, Properties and applications of Various Coatings

Unit II: Chemical Conversion Coating   9 Hours
Chromating, Phosphating, and Anodizing, Thermochemical processes: Methodology used, mechanisms, important reactions involved, Process parameters and applications.

Unit III: Coating from Vapor Phase   9 Hours
PVD, and CVD: Various Methods used, mechanisms, important reactions involved, Process parameters and applications.

Unit IV: Metallic coating   9 Hours
Hot Dipping, Galvanizing, Electrolytic and Electro less plating: Methodology used, mechanisms, important reactions involved, Process parameters and applications. Testing/ evaluation of metallic coatings.

Unit V: Thermal spray coatings   9 Hours
Processes, Types of spray guns, Comparison of typical thermal spray processes, Surface Preparation, Finishing Treatment, Coating Structures and Properties, Applications.

Text Books

1. J. R. Davis, "Surface Engineering for Corrosion and Wear Resistance", 1st Edtion, 1997.
2. George J, "Rudzki -Surface Finishing Systems metal and non-metal finishing handbook-guide", 1st Edition, Metals Park: ASM, 1983.
3. James A. Murphy, "Surface Preparation and Finishes for Metal, McGraw-Hill", New York 1971.
4. P. G. Sheasby and R. Pinner, "Surface treatment and finishing of Aluminium and its alloy", 1st Edition, ASM, Metals Park, 1987.

Reference Books

1. Friction Stir Welding and Processing, Rajiv Sharan Mishra, Partha Sarathi De, Nilesh Kumar, International 2006.
2. Friction Stir Welding and Processing, R.S. Mishra and M.W. Mahoney, ASM International, 2007.
3. Advances in Friction-Stir Welding and Processing, M-K Besharati-Givi and P. Asadi, ASM International 2008.

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Web References

1. www.nptel.iitm.ac.in
2. www.btechguru.com
3. www.ocw.mit.edu
4. www.corrosion-doctors.org

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203

MI	**20EEM03**	**Electrical Engineering Material Science**	**3**	**0**	**0**	**3**

At the end of the course, students will be able to

Code	Course Outcomes
20EEM03.1	Understand the phenomena of metal conductivity
20EEM03.2	Explain the properties of di-electric properties
20EEM03.3	Understand the magnetic properties of materials
20EEM03.4	Explain the types of semi-conductors
20EEM03.5	Understand the modern techniques used for studying the material science

Unit I: Conductivity of Metal
9 Hours

Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, energy levels of a molecule, emission of electrons from metals, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials

Unit II: Dielectric Properties
9 Hours

Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, significance of the loss tangent, dipolar relaxation, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system,

Unit III: Magnetic Properties of Materials
9 Hours

Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials

Unit IV: Semiconductors
9 Hours

Energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, thermal conductivity of semiconductors, electrical conductivity of doped materials

Unit V: Modern Techniques for Materials Studies
9 Hours

Optical microscopy – Electron microscopy – Photo electron spectroscopy – Atomic absorption spectroscopy – Introduction to Biomaterials and Nanomaterials

Text Books

1. Joseph Le Roy Hayde Proteus Steinmetz, "Radiation, Light and Illumination: A Series of Engineering Lectures Delivered at Union College", BiblioLife, 2019
2. Jack L. Lindsey, "Applied Illumination Engineering", 4ᵗʰ Edition, PHI, 2011
3. John Matthews, "Introduction to the Design and Analysis of Building Electrical Systems", 2ⁿᵈ Edition, Springer, 2013.

Reference Books

1. M.A. Cayless, "Lamps and Lighting", 5ᵗʰ Edition, Routledge, 2016.
2. Leopold Bloch, "Science of Illumination: An Outline Of The Principles Of Artificial Lighting", Kessinger Pub, 2018.

Web References

1. https://nptel.ac.in/courses/108/105/108105060/

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204

| MI | 20ECM03 | Analog Electronic Circuits | | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes
20ECM03.1	Demonstrate the concept of DC biasing and transistor stabilization leading to the design of amplifiers
20ECM03.2	Classify, analyze types of multistage amplifiers
20ECM03.3	Classify, analyze and design different types of feedback amplifiers and Oscillators
20ECM03.4	Analyze the response of different signals for linear and Nonlinear wave shaping circuits
20ECM03.5	Understand the internal operation of Op-Amp and its Applications

Unit I: Transistor Biasing
9 Hours

Need for biasing, operating point, BJT biasing methods, basic stability, fixed bias, collector to base bias, self-bias, Stabilization against variations in VBE, Ic, and β, Stability factors, (S, S', S").

Unit II: BJT and Multistage Amplifiers
9 Hours

BJT: Transistor at high frequencies, Hybrid- π common emitter transistor model, Hybrid π conductance, Hybrid π capacitances, Multistage Amplifiers: Classification of amplifiers, methods of coupling, cascaded transistor amplifier.

Unit III: Feedback Amplifiers and Oscillators
9 Hours

Feedback Amplifiers: Feedback principle and concept, types of feedback, classification of feedback amplifiers. Oscillators: Oscillator principle, condition for oscillations, types of oscillators, RC-phase shift and Wien bridge oscillators with BJT, generalized analysis of LC Oscillators, Hartley and Colpitt's oscillators using BJT.

Unit IV: Linear Wave Shaping
9 Hours

Linear wave shaping: High pass, low pass RC circuits, response for sinusoidal, step, pulse, square, ramp and exponential inputs. RC network as differentiator and integrator; Attenuators, Diode clippers.

Unit V: Linear Applications of Op-Amp
9 Hours

Internal Block Diagram of various stages of Op-Amp and Roll of each Stage, Characteristics of Op-Amp, Ideal and Practical Op-Amp specifications, Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier.

Text Books

1. Robert, L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory", 10ᵗʰ Edition, Prentice Hall of India, 2009.
2. Millman, J, TaubH, Mothiki Surya Prakash Rao and Millman's, "Pulse Digital and Switching Waveforms", 2ⁿᵈ Edition, Tata McGraw-Hill, 2008.
3. Ramakanth A. Gayakwad, "Op-Amps & Linear ICs", Prentices Hall of India, 1987.

Reference Books

1. Donald A. Neaman, "Electronic Circuit Analysis and Design", 3ʳᵈ Edition, Tata Mc Graw-Hill, 2010
2. Paul Gray, Hurst, Lewis and Meyer, "Analysis and Design of Analog Integrated Circuits", 4ᵗʰ Edition, John Willey &Sons, 2005
3. Anand Kumar, A., "Pulse and Digital Circuits", 2ⁿᵈ Edition, Prentice Hall of India, 2005
4. Sanjay Sharma, "Operational Amplifiers & Linear Integrated Circuits", 2ⁿᵈ Edition, S. K. Kataria & Sons, 2010.

Web Resource

1. https://nptel.ac.in/courses/108102112
2. https://www.udemy.com/course/analog-electronics-basic-concepts/

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205

MI   20AIM03 Interpretable Machine Learning   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20AIM03.1	Introduction to interpretability
20AIM03.2	Different interpretable models
20AIM03.3	Explain the software's for interpretable models.
20AIM03.4	Illustrate plotting of prediction changes.
20AIM03.5	Explains individual predictions of any black box classification model.

Unit I: Introduction   9 Hours
Importance of Interpretability, Taxonomy of Interpretability Methods, Scope and evaluation of Interpretability, Properties of Explanations, Human-friendly Explanations

Unit II: Interpretable Models-I   9 Hours
Data Sets-Regression, Text Classification. Interpretable Models -Linear Regression, Logistic Regression, Decision Tree, Decision Rules, Decision Rule Fit

Unit III: Interpretable Models-II   9 Hours
Generalized Linear Models (GLM) - Non-Gaussian Outcomes, Advantages; Generalized Additive Models (GAM) - Nonlinear Effects, Advantages and software; Other interpretable Models: Naive Bayes Classifier, K-Nearest Neighbors

Unit IV: Model Agnostic Methods   9 Hours
Partial Dependence Plot (PDP), Accumulated Local Effects (ALE) Plot, Feature Interaction, Functional Decomposition, Permutation Feature Importance, Global Surrogate.

Unit V: Local Model Agnostic Methods   9 Hours
Individual Conditional Expectation (ICE), Local Surrogate (LIME), Counterfactual Explanations, Scoped Rules (Anchors), Shapley Values.

Text Books

1. "Interpretable Machine Learning, A Guide for Making Black Box Models Explainable", By Christoph Molnar · 2020
2. "Interpretable Machine Learning with Python, Learn to Build Interpretable High-performance Models with Hands-on Real-world", By Serg Masis · 2021

Reference Books

1. "Explainable AI: Interpreting, Explaining and Visualizing Deep Learning", By Andrea Vedaldi, Grégoire Montavon, Klaus-Robert Müller, Lars Kai Hansen, Wojciech Samek,2019.
2. "Interpreting Machine Learning Models, Learn Model Interpretability and Explainability Methods", By Anirban Nandi, Aditya Kumar Pal · 2021

Web References

1. https://christophm.github.io/interpretable-ml-book/index.html
2. https://ai.googleblog.com/2021/12/interpretable-deep-learning-for-time.html
3. https://arxiv.org/abs/2103.10689

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| MI | **20DSM03 Data Governance** | **3** | **0** | **0** | **3** |

At the end of the course, students will be able to

Code	Course Outcomes
20DSM03.1	Understanding of the role computation can play in solving problems and optimization techniques
20DSM03.2	Understanding the usage of computational techniques.
20DSM03.3	Understanding Stochastic programming and statistical thinking
20DSM03.4	Identify the problem using Monte Carlo simulations
20DSM03.5	Plotting with the pylab package

Unit I: Introduction, Data Literacy and Concepts   9 Hours
Data is an asset, Data governance and governance, Data management, The governance "V", Solutions Other terms, Some final core concepts

Unit II: Overview: A Day in the life of a Data Governance Program and its Capabilities   9 Hours
What does it look like? - The scope of data governance and data management, Business model, Content, Development methods -Federation, Elements of data governance programs, Principles, Policies, Metrics, The critical success factors for data governance

Unit III: The Data Governance Business Case   9 Hours
The business case, Objectives of the business case for data governance, Components of the business case - The big picture (vision), Program risks, Business alignment, Costs of data quality issues, Costs of missed opportunities, Data debt, Obstacles, impacts, and changes, Presentation of the case. The process to build the business case - Fully understand business direction, identify possible opportunities, identify usage opportunities, define business benefits, confirm business benefits, quantify costs, Prepare the business case documentation, Approach considerations

Unit IV: Overview of Data Governance Development and Deployment   9 Hours
Types of approaches, The data governance delivery framework, Process overview, Engagement, Strategy, Architecture and design, Implementation, Operation, and changes

Unit V: Engagement   9 Hours
Initiation- Obtain program approval, Develop DG rollout team structure. Definition- Define DG for your organization, identify business units (subject to DG), Identify business capabilities that need data governance (and don't have it). Scope- Define scope and constraints with the initial plan for DG, Approve scope and constraints. Assessment- Information maturity, Change capacity, Data environment

Text Books

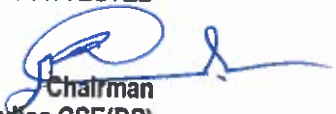1. John Ladley, "Data Governance", Academic Press, Second Edition, 2012.

Reference Books

1. Evren Eryuek, Uri Gilad, "Data Governance: The Definitive Guide", O'Reilly Media, Inc., 2021.

Web Resources

1. https://nptel.ac.in/courses/110/106/110106072/
2. https://nptel.ac.in/courses/110/104/110104094/

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MI 20SHM05   Journalism   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20SHM05.1	Understand the concepts of mass communication in general and journalism in particular
20SHM05.2	Impact fundamentals of journalism, evolutionary process, basics concepts, practices and recent trends
20SHM05.3	Get exposed to different faces of journalism
20SHM05.4	Get trained to develop inquisitive and analytical skills to be successful in media
20SHM05.5	Prepare the report for the representation

Unit I: Introduction   9 Hours
Journalism: Meaning, Definition Nature, Scope, Functions; Truth, Objectivity, verification, independent monitor, forum for criticism and comment, watch dog role of press and democracy principles of journalism will stop types of journalism: print, broadcast and online

Unit II: Process Control and Capability Analysis   9 Hours
Mass Media And Development - Early Journalism in the world, India and Karnataka global context Colin rise of advocacy journalism, professionalism, modern journalism and mobile journal journalism. Community journalism, rural journalism, yellow journalism, penny press, tabloid press, and citizen journalism

Unit III: Process-monitoring and Control Techniques   9 Hours
Journalism as a profession, responsibilities and criticism, do you know any his interest understanding the public taste, press as a tool in social service relationship between press and other mass media

Unit IV: Acceptance Sampling   9 Hours
Normative theories of press enter relevance to the present day; wire services- Indian and international news agencies

Unit V: Reliability and Life Testing   9 Hours
Photojournalism- caption writing, photo feature, visual composition- case studies Danish Siddiq, Jimmy Nelson, Margaret Brooke-white, Philip JonesGriffits, Rathika Ramaswami Raghu Rai exercise assignments analysis of daily newspaper in the classroom practice of writing new stories on various topics writing reports on civic problems incorporating information from civil organization based on interviews prepare questions for a specific interview rewriting news stories from newspapers for magazine filing report of more press conferences filing report for an actual press conference practice of writing to wall journal twice a week

Text Books
1. Keval J. Kumar (2001), Mass Communication in India, Jaico Publication, New Delhi
2. Seema Hasan (2010), Mass Communication – Principles and Concepts, CBS Publishers and distributors, New Delhi
3. V S Gupta & Vir Bala Aggarwal (2001), Handbook of Journalism and Mass Communication, Concept Publishing Company, New Delhi

Web References
3. http://wikipedia.org//wiki//media_of_india#cite
4. http://wikipedia.org//wiki//mass%2520_media__of_india#cite
5. http://wikipedia.org//wiki//mass_media_of_india#cite-buzzle

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MI 20SHM06 Statistical Quality Control   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20SHM06.1	Identify application of various Statistical quality tools
20SHM06.2	Use control chart techniques for quality improvement
20SHM06.3	planning, establishing, and operating SQC procedures
20SHM06.4	Design a procedure testing incoming batches
20SHM06.5	Carry out reliability testsand perform statistical analysis

Unit I: Introduction   9 Hours
Quality Improvement in the Modern Business Environment, Modeling Process Quality, Methods and Philosophy of Statistical Process Control

Unit II: Process Control and Capability Analysis   9 Hours
Control Charts for Variables, Control Charts for Attributes, Process and Measurement System Capability Analysis

Unit III: Process-monitoring and Control Techniques   9 Hours
Cumulative Sum and Exponentially Weighted Moving Average Control Charts, Univariate Statistical Process Monitoring and Control Techniques

Unit IV: Acceptance Sampling   9 Hours
Concepts of acceptance sampling, Lot-by-lot acceptance sampling for attributes, Other acceptance sampling techniques

Unit V: Reliability and Life Testing   9 Hours
Common models and distributions, Estimation of mean life with complete samples, Reliability Estimation, Types of reliability tests

Text Books

1. Montogomery D. C, Introduction to Statistical Quality Control (5th Edition) Wiley eastrenLtd, 2005
2. Gupta.V,Kapoor,V.K Fundamentals of Applied Statistics Sultan Chand Publications, New Delhi

Reference Books

1. Chang D. and Macmillan S. (1992). Statistical Quality Design and Control. Contemporary Concepts and Methods
2. Mahajan M. Statistical Quality Control, Danpatrai & Co Delhi
3. Gupta R.C Statistical quality Control and Quality management,10ᵗʰ Edition, Kanna Publishers, New Delhi

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6. https://www.digimat.in/nptel/courses/video/112107259/L01.html
7. https://freevideolectures.com/course/4539/nptel-operations-management/49
8. https://freevideolectures.com/course/4384/nptel-engineering-metrology/48

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▣ MI 20MBM05 Entrepreneurship and Business Venture Planning   3   0   0   3

At the end of the course, students will be able to

Code	Course Outcomes
20MBM05.1	Know the role of entrepreneurship development in economy
20MBM05.2	Understand the entrepreneurship and creativity
20MBM05.3	Understand the concept of project planning
20MBM05.4	Understand the sources of financing to ventures
20MBM05.5	Know the methods of entrepreneurship training

Unit I: Introduction   9 Hours
Concept of Entrepreneurship, Role of entrepreneurship in economic Development; factors impacting emergence of entrepreneurship, types of entrepreneurs. Characteristic of successful entrepreneurs; Women Entrepreneurs, Social entrepreneurship, Entrepreneurial challenges

Unit II: Entrepreneurship Development   9 Hours
Types of start-ups, Entrepreneurial class Theories, Entrepreneurial training; EDP Programme, Characteristics of entrepreneurial leadership, Components of Entrepreneurial Leadership, Source of innovative ideas, Entrepreneurship and creativity.

Unit III: Project Planning   9 Hours
Concept of Project and classification of Project, Identification, Project Formulation, Project Report, Project Design, Project Appraisal, Profitability Appraisal, Social cost benefit analysis, financial analysis, Developing a Marketing plan-customer analysis, sales analysis, steps in marketing research, Marketing Mix; business plan preparation, elements of a business plan; Business plan failures

Unit IV: Project Financing & Venture Capital   9 Hours
Financing Stages; Sources of Finance; Venture Capital; Criteria for evaluating new-venture proposals; Evaluating the Venture Capital-process; Sources of financing for Indian entrepreneurs.

Unit V: Entrepreneurship Training   9 Hours
Designing appropriate training programmers to inculcate entrepreneurial spirit, significance of entrepreneurial training, training for new and existing entrepreneurs, role of entrepreneurship development institutes, MSMES in providing entrepreneurial training.

Note: Discuss case studies from every unit

Text Books

1. Kumar, Arya and Entrepreneurship: Creating and Leading an Entrepreneurial Organization, Pearson, India.
2. Hishrich, Peters, Entrepreneurship: Starting, Developing and Managing New Enterprise, Irwin.

Reference Books

1. Allen K. R., Launching New Ventures: An Entrepreneurial Approach, Cengage Learning.
2. Rama Chandran K., Entrepreneurship Development, Tata McGraw-Hill, India.
3. Roy, Rajeev, Entrepreneurship, Oxford University Press
4. Vasant, Desai, Small – Scale Industries and Entrepreneurship, Himalya Publication, India

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1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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| MI | 20MBM06 | **Performance Management and Talent Management** | 3 | 0 | 0 | 3 |

At the end of the course, students will be able to

Code	Course Outcomes
20MBM06.1	Know about performance management process
20MBM06.2	Understand the performance management system
20MBM06.3	Understand the issues and challenges in implementation of performance management system
20MBM06.4	Understand the talent management approaches
20MBM06.5	Understand the talent management practices and process of companies

Unit I: Introduction
9 Hours

Performance management process, Objectives of performance management system; Historical development in India, Performance management and performance appraisal, Linkage of performance management system with other HR practices

Unit II: Performance Management System
9 Hours

Performance planning, Ongoing support and coaching, Performance measurement and evaluation, Performance management and appraisal; Methods of performance appraisal, Appraisal Communication; Counselling, Identifying potential for development, Linking pay with performance

Unit III: Issues in Performance Management
9 Hours

Implementing performance management system - Strategies and challenges, Role of HR professionals in performance management, Performance management as an aid to learning and employee empowerment, Performance management documentation, Performance management audit, Ethical and legal issues in performance management

Unit IV: Talent Management
9 Hours

Concept and approaches, Frame work of talent management, Talent identification, integration and retention

Unit V: Talent Management Practices and Process
9 Hours

Building the talent pipeline, Managing employee engagement, Key factors and different aspects of talent management, using talent management processes to drive culture of excellence

Note: Discuss case studies from every unit

Text Books

1. Bhattacharyya, D. K., "Performance Management Systems and Strategies", Pearson Education
2. Robert B, "Performance Management", McGraw-Hill Education, India
3. ASTD, "Talent Management: Strategies for success from six leading companies", Cengage Learning

Reference Books

1. Armstrong M, & Baron A, "Performance Management and Development", Jaico Publishing House, Mumbai
2. Rao T. V, "Hurconomics for Talent Management: Making the HRD missionary business – driven", Pearson Education

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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Chairman
Board of Studies (MBA)

Head of the Department
Computer Science and Engineering
N S Raju Institute of Technology
Sontyam, Visakhapatnam - 531173

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| ICC | 20ICC01 Competitive Programming | | 2 | 0 | 8 | 6 |

Version: 01.00

Duration   240 hours (2 hours theory and 14 hours practical per week) as specified above

Industry Collaborator   M/s. Demy Software Solutions, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC01.1	Understand the basics of Programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.2	Explain various types of Operators, operations, relations, and techniques in programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.3	Demonstrate gaming basics	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.4	Execute various Operations on Linked lists	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.5	Explore various applications of the techniques.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.6	Solving various problems of Binary Trees, insertion, deletion and updation.	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge
Deliverables

WEEK 1 - Introduction- Execution of a program, Decimal - Binary conversion, Ranges of Data Types and constraints, Complexity Analysis of Algorithms, Big-O Notation, Time & Space Analysis and Constraints, Importance of constraints

WEEK 2 - Bit-Manipulation, Bitwise operators, Bit-masking, Modular Arithmetic, Recursion, Thinking Recursively, Recurrence Relations, Sorting Techniques, Two Pointer Technique

WEEK 3 - Binary Search, Applications of Binary Search, Lower Bound & Upper Bound, Finding Frequency, Optimization problems, Hashing, Hashing Techniques, Collision Resolutions, Inbuilt Libraries

WEEK 4 - Maps and Sets, Subarrays and Sub sequences, String matching, Sieve of Eratosthenes, Segmented Sieve, Game Theory, Nims Game, Counting Game

WEEK 5 - Prefix and Suffix concepts, Collecting water, Stacks, Balanced Parentheses, Largest Histogram Area, Queues, Sliding Window Maximum
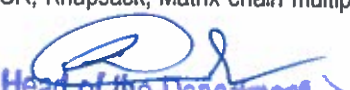
WEEK 6 - Linked Lists, Various Operations on linked lists, LRU Cache, Cloning Linked list with random pointer, Doubly-linked list

WEEK 7 - Binary Trees, BT and FBT, Traversals, Various operations on Binary Trees, Binary Search Trees, Insertion, Updating and Deletion

WEEK 8 - More Problems on Binary Trees, Iterative Traversals, Least Common Ancestor, Heaps, Quick Select, Running Median, Trie, Introduction and Implementation

WEEK 9 - Problems on Tries, Maximum XOR pair, Partitioning of string, 1D Dynamic Programming, Approaching DP problem, Problems on Overlapping subproblems, Problems on Optimal Substructure, Longest Increasing Subsequence

WEEK 10 - 2D Dynamic Programming, Compute NCR, Knapsack, Matrix chain multiplication, Graphs, Introduction and

Implementation, Dijkstra, Topological sort.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	9 (Nine)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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Chairman
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Head of the Department
Computer Science and Engineerin
N.S .Raju Institute of Technolog
Sontyam, Visakhapatnam - 53117

| ICC | 20ICC02 Web Technologies – Transferring to Practice | 2 | 0 | 8 | 6 |

Version: 01.00

| Duration | 150 hours (2 hours theory and 8 hours practical per week) as specified above |
| Industry Collaborator | M/s. Demy Software Solutions, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
		POs / PSOs	Weight	
20ICC02. 1	Learn the basics and application of HTML	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 2	Understand the CSS3 module operation	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 3	Explain JAVA script and its application	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 4	Demonstrate the basics of jQuery	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 5	Study the basics of Bootstrap and its application	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 6	Understand the basics of Angular JS	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Module 1

Introduction HTML, HTML Basics, HTML Elements, HTML5 Semantic, HTML Attributes, HTML Headings, HTML Paragraph, HTML Styles, HTML Formatting, HTML Quotations, HTML Computer Code, HTML Comments & Colours, HTML CSS, Links and Images, HTML Lists, HTML Blocks, HTML Classes, HTML Layout, HTML Responsive, HTML I frames, HTML JavaScript, HTML Head, HTML Entities and URI Code, HTML Symbols and XHTML, HTML Charset and Forms

Module 2

Introduction CSS3, CSS3 Syntax, CSS3 How To, CSS3 Colours, CSS3 Backgrounds, CSS3 Boarders, CSS Padding, CSS Height/Width, CSS3 Gradients, CSS3 Shadows, CSS3 Text, CSS3 Fonts, CSS3 2D Transforms, CSS3 3D Transforms, CSS Links, CSS Lists, CSS Tables, CSS Box Model, CSS Outline, CSS Display, CSS Max-width, CSS Position, CSS Float, CSS Inline-block, CSS Align, CSS Combinators, CSS Pseudo-class, CSS Pseudo-element, CSS Navigation Bar, CSS Dropdowns, CSS Tooltips, CSS3 Images, CSS Attr Selectors, CSS Forms, CSS Counters, CSS3 Animations, CSS3 Buttons, CSS3 Pagination, CSS3 Multiple Columns, CSS3 User Interface, CSS3 Box Sizing, CSS3 Filters, CSS3 Media Queries, CSS3 Responsive

Module 3:

Introduction to JavaScript, Java Script Language Basics, JavaScript Objects, JavaScript Scope, JavaScript Events, JavaScript Strings, JavaScript Numbers, JavaScript Math, JavaScript Arrays, JavaScript Boolean, JavaScript Comparisons, JavaScript Conditions, JavaScript Switch, JavaScript Loops, JavaScript Type Conversion, JavaScript RegExp, JavaScript Errors, JavaScript Debugging, JavaScript Hoisting, JavaScript Strict Mode, JavaScript Functions, JavaScript Objects, JavaScript Forms, JavaScript HTML DOM, JavaScript BOM

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Module 4:

Introduction to jQuery, jQuery Syntax, jQuery Selectors, jQuery Events, jQuery Effects, jQuery HTML, jQuery Traversing, jQuery AJAX, jQuery Misc.

Module 5:

Introduction to Bootstrap, Bootstrap Basics, Bootstrap Grids, Bootstrap Themes, Bootstrap CSS, Bootstrap JS

Module 6:

Introduction to AngularJS, AngularJS Expressions, AngularJS Modules, AngularJS Data Binding, AngularJS Scopes, AngularJS Directives & Events, AngularJS Controllers, AngularJS Filters, AngularJS Services, AngularJS HTTP, AngularJS Tables, AngularJS Select, Fetching Data from MySQL, AngularJS Validation, AngularJS API, AngularJS Animations, AngularJS i18n and i10n

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

ICC	20ICC03 Java Spring boot	2	0	8	6

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Demy Software Solutions, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs POs / PSOs	Weight	DoK
20ICC03.1	Understand the JAVA programming.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.2	Execute various methods in JAVA programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.3	Study and execute the OOPS concept	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.4	Demonstrate the debugging and testing of units	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.5	Learn the basics of Spring Boot	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.6	Explore the applications of Spring Boot and JAVA	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Java

Introduction to the course, software tools set up, Introduction about programming, Hello World Project and defining the main method. Variables, Starting with out expressions, Primitive data types, byte short, float, char, Boolean, double, casting.

Operators, operands, expressions. If else statement, Bit wise Operator, Ternary operator, Operator precedence and operator challenge. Keywords and expressions, statements white space and Indentation, code blocks, if then else statement.

Methods in Java, final Method. Code problems on JAVA – HACKERRANK. Method Overloading and Over riding, Control flow statements – if else, while do while, Problems on coding – Prime Number, Even Number, Fibonacci series

OOPS concept – classes, constructors and inheritance, composition, encapsulation, polymorphism, Arrays, Java list, Auto boxing and unboxing. Inner and Abstract classes and interfaces, Java Generics, Naming conventions and package, static and final keywords.

Java Collections, Debugging and unit testing, Data Bases. Basic input and output including Java.util, Concurrency in Java, Lambda expression, regular expressions

Spring Boot:

Introduction to Spring Boot – Build a hello world API, Understanding Spring boot project, Auto configuration. Create a Spring boot web application development, overview of spring boot project. Annotations, step by step code and debugging

Introduction to Junits, Mockito. Spring boot deep dive with rest API

Assessment

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Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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| ICC | 20ICC04 Robotic Process Automation | | 2 | 0 | 8 | 6 |

Version: 01.00

Duration   240 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator   M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC04.1	Explore the Robotic Automation Process	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 2	Understand the Process Flow and basic inputs and outputs	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 3	Demonstrate the functioning of Business Objects	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 4	Demonstrate the application of Object Studio attributes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 5	Explain the Case management and additional features	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 6	Understand the functioning of Error management	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Module: 1 – Robotic Automation Process Studio

Running a Process, Basic Skills, Process Validation, Decision Stage, Calculation Stage, Data Items

Module: 2 – Process Flow

Decisions, Circular Paths, Controlling Play, Set Next Stage, Breakpoints, Collections and Loops, Layers of Logic, Pages for Organization

Module: 3 – Inputs and outputs

Input Parameters, Stepping and Pages, Data Item Visibility, Data Types, Output Parameters, Start-up Parameters, Control Room, Process Outputs

Module: 4 – Business Objects

Object Studio, Business Objects, BLUE PRISM CONTENT, Action Stage, Inputs and Outputs, The Process Layer

Module: 5 – Object Studio

Creating a Business Object, Application Modeler, Spying Elements, Attributes, Attribute Selection, Launch, Wait, , Timeouts, Terminate, Write, Press, Attach and Detach, Read, Actions, Action Inputs and Outputs, Data Items as Inputs

Module: 6 – Error Management

Exception Handling, Recover and Resume, Throwing Exceptions, Preserving the Current Exception, Exception Bubbling, Exception Blocks, Exception Handling in Practice.

Module: 7 – Case Management

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Queue Items Commercial in Confidence, BLUE PRISM CONTENT, Work Queue Configuration, Defer, Attempts, Pause and Resume, Filters Reports

Module: 8 – Additional Features

Safe Stop, Collection Actions, Choice Stage, Logging, Log Viewer, System Manager, Process/Business Object, Grouping, Process and Object References, Export and Import

Module: 9 – Consolidation Exercise

Order System Process

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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N.S. Raju Institute of Technology
Sontyam, Visakhapatnam - 531173

| ICC | 20ICC05 Information Security and Forensics | | 2 | 0 | 8 | 6 |

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC05. 1	Understand the basic terminology of various servers, networking, security and hacking.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 2	Explore the web applications, testing, debugging, hacking, etc.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 3	Understand the coding techniques	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 4	Demonstrating the usage of tools for testing, hacking, etc.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 5	Execute the code using various algorithms	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 6	Perform various case studies to dive deep.	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Domain 1 – Introduction & Terminology

Global Anonymous: Proxy Server, TOR Browser, VPN, SOCKS, RDP, Psiphon, Surface Web, Deep Web, Dark Web, etc., Terminology about Web, Servers, Systems, Network Programming Languages, Hacking, IT Security, Intro to OWASP Top 10 Vulnerability. Intro to Bug Bounty & Enterprise Security and Risk Management with IT Security Life Cycle, Case Studies of Hacking, IT Security & C Forensics. Phishing + Live Hacking Impact Demonstration

Domain 2 – Hacking to Explore

Web Application Penetration Testing based in OWASP TOP 10 Vulnerabilities with Live Ex. Live Demonstration of SQLi, XSS, CSRF, and other bugs with tools and with Manual Testing. Bug Bounty, Latest CMS Exploitation, Cryptography & Practical Implementation, SSL Vulnerabilities & Live Testing, Mobile Hacking, Sniffing, Virus, Ransomware, Intro to Carding & Luhn algorithm

Domain 3 – Defence in Depth

Secure Code Review & Code Brabbing Techniques, Enterprise Security, Risk Management & Report, Tools & Web Apps Penetration Testing, Hacking Attacks & Case Studies, WAF, Firewall, Honeypots, UTM, Introduction to Security Compliance, Introduction to Mobile Apps Pen testing, Defence for Vulnerabilities

Domain 4 – Hacking Automation

Virtualization, Tools for Penetration Testing & Hacking, Kali Linux & It's Applications with Uses, Cloud Security & It's Fundamentals, SQLMAP, Metasploit, nmap etc, Exploits & Incident Response Analysis, Intro to Exploit Development & Research.

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Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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Board of Studies

Head of the Department
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Sontyam, Visakhapatnam - 531173

| ICC | 20ICC06 Battery System – Design Engineering | 2 | 0 | 8 | 6 |

Version: 01.00

| Duration | 150 hours (2 hours theory and 8 hours practical per week) as specified above |
| Industry Collaborator | M/s. Vihaan Electrix, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
		POs / PSOs	Weight	
20ICC06. 1	Determine specifications of the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.2	Design the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.3	evaluate each design option based on parameters such as safety, performance and cost	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.4	Testing and validation of the design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.5	perform safety test to minimize overcharging and overheating	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.6	perform failure mode and effect analysis of the Battery System	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Determining specifications of the Battery system

Electric Vehicle level specifications, EV specifications into Battery System level specifications, Battery potential and load requirement based on Electric Vehicle specification, list various design options / specifications available at each component level of the Battery system, selection of battery system specifications to suit specifications of cells and modules, Battery system circuit based on Battery application, electrical, mechanical or thermal interface requirements, statistical modelling and state diagrams for the battery operations.

Designing the Battery system:

Cross-functional partners to integrate the battery into the final system, designing, building, and testing code to satisfy design requirements, hardware, and software systems for battery protection, charging and gauging, design connections between anode / cathode terminals through use of suitable busbars, simulations of the designed circuit, charging and discharging of the battery in a controlled manner.

Testing and validation of the design:

design areas where checking and testing is essential, requirements for continuous automation test case, correct application for activation, using technologies of traction battery and battery charger.

Performing safety test:

test plans for batteries at the component and system level, safety test to minimize overcharging and overheating.

Performing cycle test:

failure mode and effect analysis (FMEA) of the battery system, SoC for determining electrolyte's specific gravity in each cell

by using hydrometer.

Performing load test:

load testing to remove AMPS from a battery, electrical worst-case (circuit performance), rigorous failure /root cause on battery related problems.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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| ICC | 20ICC07 Block Chain Technology | | | 2 | 0 | 8 | 6 |

Version: 01.00

Duration	150 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC07.1	Learn basics of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.2	Understand various Types of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.3	Demonstrate the concepts of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.4	Study the basics of Ethereum	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.5	Learn Solidity	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.6	Implement the Dapp	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Introduction to Blockchain

Definition of Blockchain, History of Blockchain, Explaining Distributed Ledger, Blockchain ecosystem, Explaining Distributed Ledger

Types of Blockchain

Private/Consortium/Permission-less, Public/Permissioned implementation difference, What Blockchain has to offer across Industry? Companies currently using Blockchain, Overview of what we are going to study in this course,

Key Concepts of the Blockchain

Mining -Mining algorithm, Node, peer, and block explanation, Merkle tree and Blockchain, Consensus Mechanisms- proof of work, proof of stake, How Bitcoin Blockchain works? What is Transaction?

Introduction to Ethereum

Ethereum: Blockchain with smart contract, What is Ether? Bitcoin vs Ethereum Blockchain, What is Ethereum wallet? What is Smart Contract? Ethereum clients, Geth Introduction, Setting up Private Blockchain using Geth.

Learn Solidity

Introduction to solidity, Hands on solidity, Understand and implement different use cases, Implement and deploy smart contract on Blockchain.

Implement Dapp

Setting up the environment, Tools to install – Truffle, MetaMask ,Testrpc, Implement and deploy your first Dapp, Different use cases for implementation of Dapp.

Future Scope

Talk about the future of the Blockchain, What is Hyperledger? What is Hash graph? Discussion on current

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research on Blockchain, Understand current industry challenges and needs.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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Computer Science and Engineering
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ICC 20ICC08 Network Administration

2   0   8   6

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs POs / PSOs	Weight	DoK
20ICC08.1	Understand the processes of updation, Installation of Operating System.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.2	Understand the mapping of Hardware devices	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.3	Demonstrate the management of group and Computer accounts	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.4	Explain the File System Management	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.5	Study the server administration	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.6	Explore the disaster recovery	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Overview of Networking.

Installing or Upgrading a Network Operating System, Preparing for installation, Installing from different installation mediums, Upgrade process, Identifying setup errors

Managing Hardware Devices

Understanding device drivers and PnP. Adding new devices. Hardware resource settings and driver signing, Hardware profiles

Creating and Managing Accounts

User authentication. User profiles. Creating, managing and troubleshooting user accounts.

Implementing Group and Computer Accounts

Creating group objects. Group types and scopes. Build-in groups. Creating and managing computer accounts.

Managing File Access

Introduction to file systems. Creating and managing shared folders. Managing shared folder permissions. NTFS permissions

Managing Disks and Data Storage

Disk management concepts. Managing partitions and volumes. Fault tolerant disk strategies. Monitoring disk health. Disk utilities.

Advanced File System Management

File and folder attributes. Advanced attributes. Disk quotas The distributed file system.

Implementing and Managing Printers

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Installing and sharing printers, Configuring and managing printer resources.

Using Group Policy

Creating and editing group policy objects. Group policy inheritance.

Server Administration

Procedures and standards. Terminal services and remote administration. Delegating administrative authority. Software update services.

Monitoring Server Performance and Disaster Recovery

Task manager, event viewer and performance console. Planning disaster recovery. Backing up data. Automated system recovery.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC	**20ICC09 Product Engineering**	**2**	**0**	**14**	**9**

Version: 01.00

Duration	240 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC09.1	Understand the basics of Manufacturing Process	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.2	Explain the Manufacturing Design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.3	Explore various Production Processes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.4	Demonstrate various Production Machine Operations	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.5	Study the Product monitoring	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.6	Execute the Product Logistics	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge
Deliverables
Manufacturing Process Overview
Product concepts, Market feasibility, Engineering design, Prototyping, Production, Marketing/sales

Manufacturing Design
Product analysis: Materials, Cost
Production methods: Assembly lines, Work cells, Inventory, Work flow
Quality control: Production monitoring, Product testing

Production Processes
Machine and process overviews: Boring and machining, Presses, Molding/Casting, Welding, Finishing, Assembly
Materials: Applicable types, Cost, Availability

Production Machine Operations
Presses, Molding/Casting, Drilling/Boring, Machining, Welding, Finishing, Advanced Intelligence, Automation, Programmable
Logic Controllers

Production Monitoring
Monitoring production processes: Baselines, Environmental control
Quality improvement: Production improvement

Finished Product Logistics
Delivery methods, Delivery options, Customer interaction

Assessment

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Mode of Delivery   Offline / Online

No. of transferable credits for redemption   6 (Six)

Credits validity   7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.

Dedicated certificate by the collaborating industries   Yes

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| ICC | 20ICC10 Machine Learning Engineer | 2 | 0 | 8 | 6 |

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Vihaan Electrix, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC10.1	Evaluate the existing Machine Learning (ML) processes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.2	Analyse large and complex datasets to extract insights and select the appropriate technique to be used	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.3	Develop models to achieve the business objectives	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.4	Analyses the machine learning algorithms that could be used to solve a given problem	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.5	Perform statistical analysis to resolve data set problems	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.6	Train models and optimize their hyper-parameters	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Deliverables

Prepare to Develop Machine Learning (ML) Systems:

Machine Learning (ML) processes, appropriate datasets and data representation methods, large and complex datasets to extract insights, need of retraining the existing machine programs based on objectives, data validation strategies, pre-processing or feature engineering for a given dataset, data augmentation pipelines, models to achieve the business objectives, along with the relevant metrics to track.

Develop and Assist in the Implementation of Machine Learning (ML) Systems:

Machine learning algorithms, Logistic Regression, and Naive Bayes, based on statistical modelling procedures, data cleaning to remove the irrelevant data and ensure its quality and accuracy, data acquisition process, prepare the data by transforming textual and graphical data into numbers for use in the machine learning system, create data pipeline depending on the machine learning application needs Linear Regression, , differences in data distribution, statistical analysis to resolve data set problems, solve complex problems with multi-layered data sets, use data modelling and evaluation strategy to find patterns and predict unseen instances, evaluate and transform data science prototypes.

Perform machine learning tests:

Design machine learning systems/applications and self-running Artificial Intelligence (AI) software to automate predictive models, carry out machine learning tests, interpret the test results and make appropriate adjustments based on test results, carry out research and implement best practices to improve the existing machine learning infrastructure, optimize existing machine learning libraries and frameworks based on testing, create useful information from unstructured data by auto-tagging images and text-to-speech conversions.

Train and retrain models:

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Train models and optimize their hyper-parameters, analyses the errors of the model and develop appropriate strategies to rectify them, retrain the existing systems based on new machine learning model, document the machine learning processes as per the organizational policy, follow the latest machine learning developments and technologies.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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| ICC | 20ICC11 Data Scientist | | 2 | 0 | 8 | 6 |

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Vihaan Electrix, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC11.1	Determine specifications of the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11.2	Design the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11.3	evaluate each design option based on parameters such as safety, performance and cost	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11.4	Testing and validation of the design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11.5	perform safety test to minimize overcharging and overheating	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11.6	perform failure mode and effect analysis of the Battery System	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Determining specifications of the Battery system

Electric Vehicle level specifications, EV specifications into Battery System level specifications, Battery potential and load requirement based on Electric Vehicle specification, list various design options / specifications available at each component level of the Battery system, selection of battery system specifications to suit specifications of cells and modules, Battery system circuit based on Battery application, electrical, mechanical or thermal interface requirements, statistical modelling and state diagrams for the battery operations.

Designing the Battery system:

Cross-functional partners to integrate the battery into the final system, designing, building, and testing code to satisfy design requirements, hardware, and software systems for battery protection, charging and gauging, design connections between anode / cathode terminals through use of suitable busbars, simulations of the designed circuit, charging and discharging of the battery in a controlled manner.

Testing and validation of the design:

design areas where checking and testing is essential, requirements for continuous automation test case, correct application for activation, using technologies of traction battery and battery charger.

Performing safety test:

test plans for batteries at the component and system level, safety test to minimize overcharging and overheating.

Performing cycle test:

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failure mode and effect analysis (FMEA) of the battery system, SoC for determining electrolyte's specific gravity in each cell by using hydrometer.

Performing load test:

load testing to remove AMPS from a battery, electrical worst-case (circuit performance), rigorous failure /root cause on battery related problems.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC	**20ICC12 Industrial IOT**	**2**	**0**	**8**	**6**

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC12.1	Understand the basics of IIOT & IOT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.2	Demonstrate the components of IIOT & IOT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.3	Describe the Communication Technologies of IIoT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.4	Analyze the Visualization and Data Types of IIoT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.5	Describe the methods of Retrieving the data	1, 2, 3 & PSO1	3	L1-L3
20ICC12.6	Explain the Control & Supervisory Level of Automation	1, 2, 3 & PSO1	3	L1-L3

Deliverables
MODULE 1: Introduction & Architecture
Theory
IIoT and connected world, the difference between IoT and IIoT, Architecture of IIoT, IOT node, Challenges of IIOT.
Practice
Introduction to Arduino, ESp8266, Introduction to raspberry Pi.

MODULE 2: IIOT Components
Theory
Fundamentals of Control System, introductions, components, closed loop & open loop system.
Introduction to Sensors (Description and Working principle): Sensor, Types of sensors, working principle of basic Sensors - Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11). Digital switch, Electro Mechanical switches.
Practice
Measurement of temperature & pressure values of the process using raspberry pi/node mcu.
Modules and Sensors Interfacing (IR sensor, Ultrasonic sensors, Soil moisture sensor) using Raspberry pi/node mcu.
Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry pi/node mcu.

MODULE 3: Communication Technologies of IIoT
Theory
Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID
Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and Profibus technology, wireless network communication.
Practice
Demonstration of MQTT communication.
Demonstration of LoRa communication.

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MODULE 4: Visualization and Data Types of IIoT

Theory

Front-end EDGE devices, Enterprise data for IIoT, Emerging descriptive data standards for IIoT, Cloud data base, Cloud computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

Practice

Visualization of diverse sensor data using dashboard (part of IoT's 'control panel')

Sending alert message to the user. ways to control and interact with your environment)

MODULE 5: Retrieving Data

Theory

Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

Practice

Device control using mobile Apps or through Web pages.

Machine to Machine communication.

MODULE 6: Control & Supervisory Level of Automation

Theory

Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). HMI in an automation process, ERP & MES.

Practice

Digital logic gates programming using ladder diagram.

Implementation of Boolean expression using ladder diagram.

Simulation of PLC to understand the process control concept.

MODULE 7: Application of IIOT

Case study: Health monitoring, Iot smart city, Smart irrigation, Robot surveillance.

Assessment

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