NSRIT

AUTONOMOUS

ACADEMIC RULES & REGULATIONS

2020

U. G. PROGRAMS

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

Academic Rules and Regulations

2020

Undergraduate Programs

Choice Based Credit & Semester System (CBCSS)

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

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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 Kakinada (JNTUK, Kakinada)

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, Medical Common Entrance Test (AP – EAMCET). 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 three 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 six 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 four 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 stiupulated 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 sixteen weeks of instruction, one week of practical examinations and three to four weeks for descriptive examinations. In total, each semester will span for a maximum duration of 16 – 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 (HSS)
    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)
f. Mandatory Courses(MC) as prescribed by AICTE / UGC

5.2. Nomenclature of Credit Distribution

No.	Nature of Course	Credit
1	Theory Course / Elective Course (per Hour)	1.0
2	Practical / Drawing Course (per Hour)	0.5
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
7	Skill Advanced / Soft Skill Course (per Hour)	2.0
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 (HSS) + 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	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**

[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 percentage of various conginitve levels of RBT pertaining to each course is indicated in the syllabus to enable the examiner to develop the assessment instrument in the form of question paper to measure the attainment of course outcomes (COs) that contributes to the attainment of Program Outcomes (POs).The question papers shall be designed with a combination of short answer (40% may be from self study topics) and long answer questions or MCQ that fits best to the assessment. With regard to the assessment pattern for the skill oriented courses, appropriate assessment instrument shall be developed by the respective department that suits to assess the skills that are expected from the courses by taking approval from the competent authority of the Institution before deploying for assessment.

5.6. Internship

As per the guidelines specified in these regulations, each student is expected to undergo 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 six weeks. 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 VIIIshall 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.

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.In case, 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 precirbed 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 in line 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 conitnuos assessment as well as fulfilling the attendance requirement. 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. In addition to the above, the curriculum provides flexibility to nurture employability skills through audit courses and it 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.

5.9. MOOCs and Self Study Courses

The Curriculum provides adequate flexibility for the students to take up MOOCs through self-study mode enabling them to learn the courses on independent mode with minimal guidance of faculty mentor to earn 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 Board of Studies (BoS). The evaluation and 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 courses. However, the evaluation and assessment of MOOCs for B. Tech. (Honors) and B. Tech. (Minor with speciliazation) 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 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. This semester away program provides flexibility to the students to select the semester VII either with regular courses as specified in the curriculum or with the semester away program.

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 one credit or two 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 one- credit or two 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 7.5 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 Examination #1 and #2

Descriptive Examination	: 20 Marks
Objetive Type Examination	: 05 Marks
Assignment	: 05 Marks

The final internal marks will be awarded by considering 80% of marks secured in the best of the two continuous internal evaluation and 20% marks secured in the other internal test.

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

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 80% of marks secured in the best of the two internal tests and 20% marks secured in the other internal test. The marks obtained will be added to the marks secured during the continuous assessment process.

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	: 20 Marks (Presentation)
Report	: 30 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	: 20 Marks
Outcomes	: 20 Marks
Final Presentation	: 10 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	: 20 Marks
Interim Review #1(Presentation)	: 05 Marks

Interim Review #2 (Presentation)	: 05 Marks
Product Development	: 20 Marks
Terminal Presentation	: 10 Marks
Report	: 10 Marks

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 in the semester end examinations Continuous Internal Assessent (CIA) and Semester End Examinations (SEE) and
- A minimum of 40% marks (16 and above out of 30 marks) for each course considering both CIA and SIE 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 eight consecutive academic years (Regular) and six 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 five 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 four 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 eight 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 aAutonomous / Non-Autonomous Institution affiliated to JNTUK
- Within the Institution from one regulation to other academic regulation

a. Transfer of a candidate from aAutonomous / 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 third semester, 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 depemding on the total number of students registered for that particular course and the Chairpeson 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. **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.

17. 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.

18. 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.

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

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

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

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

No.	Code	Course	POs	Contact Hours				
				L	T*	P	C	
Semester I								
01	20HSX01	Communicative English	10	3	0	0	3.0	HS
02	20BSX11	Linear Algebra and Differential Equations	1, 12[1]	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								
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 and Electronics Engineering Lab	1, 4	0	0	3	1.5	ES
09	20MCX01	Environmental Science	1	2	0	0	-	MC
			Sub-total	17	05	09	**19.5**	
Semester III								
01	20BSX16	Mathematical Foundations of Computer Science	1	3	1	0	3.0	BS
02	20CS302	Design and Analysis of Algorithms	1	3	1	0	3.0	PC
03	20CS303	Database Management Systems	1, PSO 1	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	1, 4	0	0	3	1.5	PC
07	20CS307	Database Management Systems Lab	1, 4, PSO 1	0	0	3	1.5	PC
08	20CS308	Object Oriented Programming through C++ Lab	1, 4	0	0	3	1.5	PC
09	20CSS01	Programming Basics	3	1	0	2	2.0	SC
10	20MCX02	Constitution of India	-	2	0	0	-	MC
			Sub-total	18	04	11	**21.5**	

*Suggested hours for tutorial

[1]By default all courses are mapped to PO 12 as they area weakly contributing

No.	Code	Course	POs	Contact Hours				
				L	T	P	C	
Semester IV								
01	20HSX03	Managerial Economics and Financial Analysis	11	3	0	0	3.0	HS
02	20CS402	Data Ware Housing 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, 2, 3	3	1	0	3.0	PC
05	20CS405	Theory of Computation	1, 2	3	1	0	3.0	PC
06	20CS406	Data Ware Housing and Mining Lab	4, 2	0	0	3	1.5	PC
07	20CS407	Python Programming Lab	1	0	0	3	1.5	PC
08	20CS408	Operating Systems Lab	3, 4	0	0	3	1.5	PC
09	20AIS02	Competitive Programming Essentials	3, 4, 5	1	0	2	2.0	SC
			Sub-total	16	03	11	**21.5**	
Semester V								
01	20CS501	Java Programming	1	3	1	0	3.0	PC
02	20CS502	Computer Networks	3, 5	3	0	0	3.0	PC
03	20AI502	Artificial Intelligence	1, 2, 3	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	4, 5	0	0	3	1.5	PC
08	-	MOOCs	12	0	0	4	2.0	SC
09	20MCX03	Intellectual Property Rights and Patents	-	2	0	0	-	MC
10	-	Summer Internship#1[2]	5, 8, 9, 10, PSO 1	0	0	3	1.5	IN
11	-	Technical Paper Writing	-	0	0	2	-	AC
			Sub-total	17	02	15	**21.5**	
Semester VI								
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	Android App Development	5, PSO 1, PSO 2	1	0	2	2.0	SC
10	20MCX04	Indian Traditional Knowledge	-	2	0	0	-	MC
			Sub-total	18	0	11	**21.5**	
Semester VII								
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	-	3	0	0	3.0	OE
05	-	Open Elective IV	-	3	0	0	3.0	OE
06	20HSX04	Professional Ethics	8	3	0	0	3.0	HS
07	20CSS05	Finishing School for CSE	1-12	1	0	2	2.0	SC
08	-	Summer Internship #2[2]	5, 8, 9, 10, PSO 1	0	0	0	3.0	IN
			Sub-total	19	0	02	**23.0**	
Semester VIII								
01	-	Full Semester Internship[3]	5-10, PSO 1, PSO 2	0	0	0	06	IN
02	-	Capstone Project/Interdisciplinary Project[3]	5-10, PSO 1, PSO 2	0	0	0	06	IN
			Sub-total	0	0	0	**12.0**	
			Total Credits	-	-	-	**160**	

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

[3] The students opting for FSI in VII Semester should take up the courses of VII Semester in VIII Semester

List of Electives

Professional Elective #1								
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	20AI302	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
Professional Elective #2								
6	20CS006	Software Quality Management	-	3	0	0	3.0	PE
7	20DS302	Foundations of Data Science	-	3	0	0	3.0	PE
8	20AI503	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
Professional Elective #3								
11	20CS011	Software Testing Methodologies	-	3	0	0	3.0	PE
12	20DS502	Big Data	-	3	0	0	3.0	PE
13	20AI603	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
Professional Elective #4								
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	20CS020	Digital Image Processing and Applications	-	3	0	0	3.0	PE
Professional Elective #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								
25	20CEO01	Urban Environmental Health	-	3	0	0	3.0	OE
26	20CSO01	Data Structures and Algorithms	-	3	0	0	3.0	OE
27	20AIO01	Machine Learning for Engineers	-	3	0	0	3.0	OE
28	20DSO01	Introduction to Database Management Systems	-	3	0	0	3.0	OE
29	20ECO01	Architectures and Algorithms of IoT	-	3	0	0	3.0	OE
30	20EEO01	Introduction to Renewable Energy Sources	-	3	0	0	3.0	OE
31	20MEO01	Nano Technology	-	3	0	0	3.0	OE
32	20SHO01	Women and Society	-	3	0	0	3.0	OE
Open Elective #2								
33	20CEO02	Ecology, Environmental & Resource Management	-	3	0	0	3.0	OE
34	20CSO02	Designing the Internet of Things	-	3	0	0	3.0	OE
35	20AIO02	Fundamentals of Deep Learning	-	3	0	0	3.0	OE
36	20DSO02	Introduction to Data Science	-	3	0	0	3.0	OE
37	20ECO02	IoT for Smart Grids	-	3	0	0	3.0	OE
38	20EEO02	Electrical Safety and Management	-	3	0	0	3.0	OE
39	20MEO02	Fundamentals of Automobile Engineering	-	3	0	0	3.0	OE
Open Elective #3								
40	20CEO03	Disaster, Risk Mitigation and Management	-	3	0	0	3.0	OE
41	20CS404	Operating Systems	-	3	0	0	3.0	OE
42	20AIO03	Fundamentals of AI	-	3	0	0	3.0	OE
43	20DSO03	Introduction to Big Data	-	3	0	0	3.0	OE
44	20ECO03	Privacy and Security in IoT	-	3	0	0	3.0	OE
45	20EEO03	Low-cost Automation	-	3	0	0	3.0	OE
46	20MEO03	Industrial Automation	-	3	0	0	3.0	OE
47	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 regulation 2020.								OE
B. Tech. (Honors)								
Category I								
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 Mat lab	-	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)[4]								
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 and 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	20MBM02	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	Organization Behaviour	-	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	20SHM06	Journalism	-	3	0	0	3.0	MI
31	20SHM07	Statistical Quality Control	-	3	0	0	3.0	MI

[4] The students who are pursuing U.G. program offered by the Department of Computer Science Engineering can opt Minors offered by the other departments

32	20MBM05	Entrepreneurship & Business Venture Planning	-	3	0	0	3.0	MI
33	20MBM06	Performance Management & Talent Management	-	3	0	0	3.0	MI

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

List of Minor's offered by the freshman engineering and Management studies such as

1. Liberal Arts
2. Statistics
3. General Management
4. Human Resource Management - these will be implemented for the 2021 admitted students

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

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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PE 20DS502 Big Data 3 0 0 3

Pre- Requisite Linux, Distributed Computing

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

Code	Course Outcomes	Mapping with POs	DoK
20DS502.1	Able to understand the building blocks of Big Data	-	L1, L2
20DS502.2	Articulate the programming aspects of cloud computing (map Reduce etc)		L1, L2
20DS502.3	Understand the specialized aspects of big data with the help of different big data applications		L1, L2
20DS502.4	Able to represent the analytical aspects of Big Data		L1, L2
20DS502.5	Know the recent research trends related to Hadoop File System, MapReduce, and Google File System		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: Working with Big Data 9 Hours

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, Name node, Data node, Secondary Name node, Job Tracker, Task Tracker

Google File System, Building Blocks of Hadoop

Unit II: Configuring Hadoop Cluster 9 Hours

Hadoop's History, Core Hadoop Concepts, Hadoop Clusters, Installation and Configuration Local, Pseudo-distributed mode, Fully Distributed mode, Configuring XML files, Data structures in Java: Linked List, Stacks, Queues, Sets, Maps; Generics: Generic classes and Type parameters, Implementing. Java Generic Types, Generic Methods, Wrapper Classes, Concept of Serialization

Core Hadoop Concepts, Hadoop's History

Unit III: Writing MapReduce Programs 9 Hours

A Weather Dataset, Understanding Hadoop API for MapReduce Framework (Old and New), Basic programs of Hadoop MapReduce: Driver code, Mapper code, Reducer code, Record Reader, Combiner, Partitioner

Hadoop API

Unit IV: Hadoop I/O 9 Hours

The Writable Interface, Writable Comparable and comparators, Writable Classes: Writable wrappers for Java primitives, Text, Bytes Writable, Null Writable, Object Writable and Generic Writable, Writable collections, implementing a Custom Writable: Implementing a Raw Comparator for speed, Custom comparators

Null Writable, Writable Wrappers

Unit V: Importing and Exporting Data from Various DBs 9 Hours

Pig: Hadoop Programming Made Easier Admiring the Pig Architecture, going with the Pig Latin Application Flow, working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin, Applying Structure to Hadoop Data with Hive: Saying Hello to Hive, Seeing How the Hive Is Put Together, Getting Started with Apache Hive, Examining the Hive Clients, Working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works, Querying and Analysing Data

Comparisons of pig, Hive

Text Books

1. Cay Horstmann, "Big Data", Fourth Edition, Wiley John Wiley & Sons, INC
2. Chuck Lam, "Hadoop in Action", MANNING Publ
3. Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss, "Hadoop for Dummies"

Reference Books

1. Tom White, "The Definitive Guide", Third Edition, O'reilly
2. Chuck Lam, "Hadoop in Action", MANNING Publ

Web Resources

1. Hadoop: http://hadoop.apache.org/
2. Hive: https://cwiki.apache.org/confluence/display/Hive/Home
3. Piglatin: http://pig.apache.org/docs/r0.7.0/tutorial.html

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. Explain Write Types of keys and Values mapper, reducer, combiner (if any) and which of the types need to Writable
2. Explain various generic methods and classes supported by java
3. Explain Why linked lists, stacks and queues are called as linear data structures
4. What is the use of generic methods and generic classes in java?
5. What are different Hive Data Types. And how to Manage Databases and Tables in hive?

L2: Understand

1. Explain about the implementation of map reduce concept with a small example
2. Explain the operations performed on stacks and queues with examples
3. How to create a table by using HIVE
4. List the difference between the 'set' & a 'map' data structure and explain about various map implementations in java with suitable examples
5. List the relational operators in Pig? And What are the components of Pig Execution Environment

L3: Apply

1. What is the necessity of pig Latin? And explain the three key design principles of pig Latin
2. Discuss Pig Latin Application Flow
3. What are views in HIVE? What is the difference between internal and external table?
4. Explain the uses of Name node, Data node and Secondary Name node in Hadoop Distributed File system

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PE 20AI603 Deep Learning Principles and Practices 3 1 0 3

Pre- Requisite Machine Learning, Linear Algebra, Statistics

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

Code	Course Outcomes	Mapping with POs	DoK
20AI602.1	Understand the basic concepts of deep learning	-	L1
20AI602.2	Illustrate different deep learning models		L1, L2
20AI602.3	Explain dimension reduction techniques		L1, L2
20AI602.4	Describe the optimization in deep learning networks		L1, L2
20AI602.5	Analyse the deep learning applications		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

9 + 3 Hours

Unit II: Deep Networks

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

9+3 Hours

Unit III: Dimensionality Reduction

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

9+3 Hours

Unit IV: Optimization and Generalization

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.

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

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

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

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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PE 20DS603 Data Visualization 3 0 0 3

Pre- Requisites Descriptive Statistics, Data Analysis Skills

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

Code	Course Outcomes	Mapping with POs	DoK
20DS603.1	Explain Data Visualization	-	L1
20DS603.2	Articulate existing visualization tools and techniques to analyse basic datasets		L1
20DS603.3	Apply Plot for data visualization		L1, L2
20DS603.4	Conduct exploratory data analysis using Tableau.		L1, L2
20DS603.5	Articulate issues and techniques for story telling		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 9 Hours

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”, 1st Edition, Addison-Wesley Data & Analytics Series, 2018 (Unit 4 to 5)

Reference Books

1. Kyran Dale, “Data visualization with python and java script”, 1st t Edition, O'Reilly Media, Inc., 2016
2. Claus O. Wilke, “Fundamentals of Data Visualization”, 1st Edition, O'Reilly Media, Inc., 2019

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: Remember

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: Understand

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

Pre- Requisites Computer Networks, Operating Systems, Linux

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

Code	Course Outcomes	Mapping with POs	DoK
20AI005.1	Understand the components of cyber security	-	L1, L2
20AI005.2	Describe the need of security for operating systems and networks		L1, L2
20AI005.3	Explain the countermeasures of security attacks		L1, L2
20AI005.4	Understand the importance of privacy		L1, L2
20AI005.5	Explain the implementation of organizational security		L1, L2
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 -Harm - Vulnerabilities - Controls - Authentication - Access Control and Cryptography - Web—User Side - Browser Attacks - Web Attacks Targeting Users - Obtaining User or Website Data

Email attacks

Unit II: Security in Operating Systems and Networks **9 Hours**

Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service

Distributed Denial-of-Service

Unit III: Security Countermeasures **9 Hours**

Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity

Database Disclosure

9 Hours

Unit IV: Privacy in Cyberspace

Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining -Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies

Advantages of Privacy

Unit V: Organizational Security **9 Hours**

Policies, Procedures, Standards, and Guidelines - Security Awareness and Training - Interoperability Agreements - The Security Perimeter - Physical Security - Environmental Issues - Wireless - Electromagnetic Eavesdropping

Issues and Challenges in Organized Security

Text Books

1. Charles P. Pfleeger, Shari Lawrence and Pfleeger Jonathan Margulies, “Security in Computing”, Fifth Edition, Pearson Education, 2015
2. George K. Kostopoulous, “Cyber Space and Cyber Security”, CRC Press, 2013
3. Martti Lehto, Pekka Neittaanmäki, “Cyber Security: Analytics, Technology and Automation”, Springer International Publishing Switzerland 2015

Reference Books

1. W.A.Coklin W. A. and White G., “Principles of Computer Security”, Fourth Edition, McGrawHill, 2016
2. Charlie Kaufman, Radia Perlman, and Mike Speciner, “Network Security: PRIVATE Communication in a PUBLIC World”, Prentice Hall, ISBN 0-13-046019-2

Web Resources

1. https://www.newhorizons.com/promotions/cybersecurity-ebooks

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 Cyber Security?
2. What are the different authentication tools?
3. Define Data Mining?

L2: Understand

1. Explain different Security Counter Measures.
2. Explain Privacy Impacts of Emerging Technologies.

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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.

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 20CS020 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.

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

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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OE 20CS404 Operating Systems 3 0 0 3

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

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.

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

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

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

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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Board of Studies (ME)

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

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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IN Summer Internship #2 0 0 0 3

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	Exhibit communication skills in terms of oral, written, and graphical communications
5	Demonstrate 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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IN 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 behaviour 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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IN Capstone Project/ Interdisciplinary 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 behaviour 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 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

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

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

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 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	Analyse 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.

Web Resources

1. https://www.geeksforgeeks.org/difference-between-parallel-computing-and-distributed-computing/

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HO 20DSH10 Data Preparing 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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Board of Studies CSE(DS)

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 - Behaviour 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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Board of Studies(CE)

MI 20CSM01 E-Commerce 3 0 0 3.0

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

Code	Course Outcomes	Mapping withPOs	DoK
20CSM01.1	Explain the role of new internet economy in E-Commerce	-	L1,L2
20CSM01.2	Explain the architecture of World Wide Web		L1,L2
20CSM01.3	Describe the E-Commerce process models and E-Payment System		L1,L2
20CSM01.4	Illustrate the network models in customization and internal commerce		L1,L2
20CSM01.5	Explain the E-commerce models in advertising and marketing of business		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**

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, Technologybehind 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 Intraorganizational 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

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 LevelsL1: 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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Board of Studies (CSE)

MI 20MEM01 Biomaterials **3 0 0 3**

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

Code	Course Outcomes	Mapping withPOs	DoK
20MEM01.1	Classify various biomaterials	-	L1,L2
20MEM01.2	Identify the Metallic implant materials		L1,L2, L3
20MEM01.3	Describe the failure modes of implant materials		L1,L2
20MEM01.4	Apply Ceramic implant materials		L1,L2, L3
20MEM01.5	Develop the Biocompatibility & Toxicological properties in of biomaterials		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 **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 Text 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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Board of Studies(ME)

MI **20EEM01 Basic Control Systems** **3 0 0 3**

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEM01.1	Determine time response specifications of second order systems		L1-L2
20EEM01.2	Determine error Constants for different types of input signals		L1-L2
20EEM01.3	Understand various levels of illuminosity produced by differentilluminating sources.		L1-L3
20EEM01.4	Design different lighting systems by taking inputs and constraints in view for different layouts.		L1-L3
20EEM01.5	Understand the speed/time characteristics of different types oftraction motors.		L1-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 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

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 LevelsL1: 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.$s^5+2s^6+3s^5+s^4+5s^3+2s^2+s+7=0$. Determine the the stability of thesystem 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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Board of Studies (EEE)

MI **20ECM01 Semiconductor Devices and Circuits** **3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20ECM01.1	Classify different types of semiconductors with energy band diagrams	-	L1, L2
20ECM01.2	Explain the operation and characteristics of PN junction diode and special diodes		L1, L2
20ECM01.3	Classify and Analyze different types of rectifiers		L1, L2, L3
20ECM01.4	Demonstrate the flow of current in different configurations of the transistor & the concept of DC biasing and transistor stabilization		L1, L2, L3
20ECM01.5	Analyze and Design the small signal low frequency amplifiers		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: 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 VBE, Ic, 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 (C_e) 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

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	Mapping with POs	DoK
20AIM01.1	Describe the concepts of artificial neural networks	-	L1, L2
20AIM01.2	Compare functions of biological and artificial neural networks		L1, L2
20AIM01.3	Explain the architecture and functioning of Single Layer feed forward networks		L1, L2
20AIM01.4	Describe architecture and functioning of Multi-layer networks		L1, L2
20AIM01.5	Explain associative memory networks		L1, L2
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

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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MI **20DSO03 Introduction to R Programming** **3 0 0 3.0**

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

Code	Course Outcomes	Mapping withPOs	DoK
20DSO03.1	Understand the basic concepts of R programming	-	L1, L2
20DSO03.2	Understand about Scalars and Vectors		L1, L2,
20DSO03.3	Implement Lists and data Frames		L1, L2, L3
20DSO03.4	Implement Tables and Statistical Distributions		L1, L2 , L3
20DSO03.5	Implement Functions in R programming		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**

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-Like 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

Aaggregate () 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

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 LevelsL1: 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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Board of Studies (CSE)

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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Board of Studies

MI 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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Board of Studies

MI 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 10 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 10 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 10 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 10 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 10 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

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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 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 10 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 10 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 10 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 10 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 10 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

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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 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

UnitI: 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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Board of Studies(CE)

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.

Web Resources

1. https://www.tutorialspoint.com/
2. https://www.coursera.org/learn/

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Board of Studies (CSE)

MI 20MEM02 Micro Electromechanical Systems 3 0 0 3

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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1. https://nptel.ac.in/courses/117/105/117105082/

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Board of Studies (ME)

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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Board of Studies (EEE)

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 switchingfunctions
20ECM02.3	Design of various combinational logic circuits using basic gates
20ECM02.4	Design various simple programmable logic devices to complexprogrammable 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", 3rdEdition, Tata McGraw Hill, 2003
3. Charles Roth, H. and Larry Kinney, L.Jr., "Fundamentals of Logic Design", 7th Edition, Cengage Learning, 2014

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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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Board of Studies (ECE)

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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Board of Studies CSE(AI/ML)

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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Board of Studies CSE(DS)

MI **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

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 Statistics", 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 3 0 0 3

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)

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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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

Web References

1. http://mcic.ca
2. https://www.drishtiias.com
3. https://www.jica.go.jp

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Board of Studies (CE)

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, and 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

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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Board of Studies (CSE)

MI 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.

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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Board of Studies (ME)

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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Board of Studies (EEE)

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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Board of Studies (ECE)

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 Masís · 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 20SHM06 Journalism 3 0 0 3

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

Code	Course Outcomes
20SHM01.1	Understand the concepts of mass communication in general and journalism in particular
20SHM01.2	Impact fundamentals of journalism, evolutionary process, basics concepts, practices and recent trends
20SHM01.3	Get exposed to different faces of journalism
20SHM01.4	Get trained to develop inquisitive and analytical skills to be successful in media
20SHM01.5	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 20SHM07 Statistical Quality Control 3 0 0 3

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

Code	Course Outcomes
20SHM08.1	Identify application of various Statistical quality tools
20SHM08.2	Use control chart techniques for quality improvement
20SHM08.3	planning, establishing, and operating SQC procedures
20SHM08.4	Design a procedure testing incoming batches
20SHM08.5	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

Web References

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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