DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FACULTY OF ENGINEERING & ARCHITECTURE

SYLLABUS

BACHELOR OF ENGINEERING

COMPUTER SCIENCE AND ENGINEERING

(Semester Scheme)

FOUR YEAR INTEGRATED COURSE

B.E. Second Year Examination, 2021
B.E. Third Year Examination, 2022
B.E. Final Year Examination, 2023

JAI NARAIN VYAS UNIVERSITY
JODHPUR

NOTIFICATION

In compliance to decision of the Hon'ble High Court all students are required to fulfil the 75% attendance in each subject and there must be 75% attendance of the student before he/she could be permitted to appear in the examination

GENERAL INFORMATION FOR STUDENTS

LIST OF TEACHING STAFF

TEACHING AND EXAMINATION SCHEME
B.E. SECOND YEAR : SEMESTER III
: SEMESTER IV

TEACHING AND EXAMINATION SCHEME
B.E. THIRD YEAR : SEMESTER V
: SEMESTER VI

TEACHING AND EXAMINATION SCHEME
B.E. FOURTH YEAR : SEMESTER VII
: SEMESTER VIII

LIST OF TEACHING STAFF

PROFESSOR

1. **Dr. N.C. Barwar (HEAD)** BE, ME, Ph.D., MISTE, MIE
2. Dr. Anil Gupta BE (Hons), M.Tech., Ph.D., MCSI, MISTE,MIE

ASSOCIATE PROFESSOR

1. Shri Shrwan Ram BE, ME

ASSISTANT PROFESSOR

1. Dr. (Mrs.) Rachna MCA, ME, Ph.D.
2. Dr. Alok Singh Gahlot BE, MS, Ph.D.
3. Ms Simran Choudhary B.Tech., ME
4. Shri Abhisek Gour B.Tech., ME

Bachelor of Engineering
Four Year Integrated Course
Academic Rules

1. **Admission :**
   A candidate for admission to the four year degree programme for B.E. (Building & Construction Technology, Civil Engineering, Chemical Engineering, Computer Science & Engineering, Electrical Engineering, Electronics & Communication Engineering, Electronics & Computer Engineering, Electronics & Electrical Engineering, Information Technology, Mechanical Engineering, Mining Engineering, Production & Industrial Engineering must have passed (10+2) Senior Secondary (with English, Physics, Chemistry & Mathematics) of a board situated in state of Rajasthan or other examinations recognized as equivalent or higher thereto and selected through REAP or otherwise as per the procedure laid down by the University/State Govt. time to time.
2. **Duration of course :**
   The course of study shall extend over a period of four years (eight semesters as an integrated course). A student shall follow the prescribed course as given in the teaching and examination scheme of the course to which he/she is admitted.
3. **Examination Rule :**
   a. There shall be a theory examination (Main Examination) at the end of each Semester in Building & Construction Technology, Civil Engineering, Chemical Engineering, Computer Science & Engineering, Electrical Engineering, Electronics & Communication Engineering, Electronics & Electrical Engineering, Electronics & Computer Engineering, Information Technology, Mechanical Engineering, Mining Engineering, Production & Industrial Engineering viz.,

At the end of First Semester	:	First B.E., First Semester Examination
At the end of Second Semester	:	First B.E., Second Semester Examination
At the end of Third Semester	:	Second B.E., Third Semester Examination
At the end of Fourth Semester	:	Second B.E., Fourth Semester Examination
At the end of Fifth Semester	:	Third B.E., Fifth Semester Examination
At the end of Sixth Semester	:	Third B.E., Sixth Semester Examination
At the end of Seventh Semester	:	Final B.E., Seventh Semester Examination
At the end of Eighth Semester	:	Final B.E., Eighth Semester Examination

   b. Practical and Sessional examinations of odd and even semester of First B.E., Second B.E., Third B.E. & Fourth B.E. will be held at the end of each semester of the year.
   c. A candidate will be given marksheet at the end of semester examination of I, II, III & IV year of the respective semester/year to indicate performance of the candidate as per the scheme of teaching and examination after the declaration of result.
4. **Attendance Required:**
   The attendance requirement in the Faculty of Engineering & Architecture shall be, "In compliance of the decision of the Hon'ble High Court all students are required to fulfil the 75% attendance rule in each subject and there must be 75% attendance of the student before he/she could be permitted to appear in the examination".
   (a) **Condonation of shortage of attendance:** The shortage of attendance up to the limits specified below may be condoned on valid reasons:
   (b) Upto 6% in each subject plus 5 attendances in all aggregate of subject/papers may be condoned by the Vice-Chancellor on the recommendation of the Dean/Director/Principal for undergraduate students and on the recommendation of the Head of the Department for the Post-graduate students.

(c) The N.C.C./N.S.S. Cadets sent out to parades and camps and such students who are deputed by the University to take part in games, athletics or cultural activities may for- purposes of attendance be treated as present for the days of these absences in connection with the aforesaid activities and that period shall be added to their subject wise attendance.

5. BE First Year Examination:

(a) A candidate who has attended a regular course of study in the Faculty of Engineering & Architecture for the first semester of first B.E. shall be eligible for appearing at the second semester examination of first B.E. for the B.E. degree which shall be common to all branches.

(b) Every candidate appearing for the first semester of first B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

(c) A candidate who has attended a regular course of study for the second semester of first B.E. and has appeared in the first semester examination shall be eligible for appearing at the second semester examination of first B.E. for the B.E. degree, which shall be common to all branches.

(d) Every candidate appearing for the second semester of first B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

6. Continuous Assessment and Scheme of Examination:

The evaluation of students in a course will be a continuous process and will be based on their performance in Course Work Sessionals (CWS), and End-Term Examination (ETE). The Course work Sessional Exams shall include attendance, quizzes, tutorials, home work assignments, term papers, seminars, presentations, attendance, surprise test / class tests / MCQ tests / open book tests / Group activities etc. and may be conducted by the Course Instructor / Coordinator during the semester as per his / her course plan. Laboratory courses will have Practical Sessionals (PRS) such as practicals, field work etc. and a Practical End Term Exam (PRE).

(1) A student who fails to appear in the course work sessional due to sudden illness or mishap / accident and is supported by Medical Certificate, may be allowed to take another examination within two weeks of the exam with the permission of the concerned instructor with intimation to Head of the Department. Such exams should be conducted only for 75% of the marks of the original exam.

7. BE Second Year Examination:

(a) The course of study for the Second B.E. Examination shall be separate for all branches of study.
A candidate who after passing I & II semester of I B.E. examination and has attended regular course of study in a particular branch of Engineering for the Third Semester second B.E. shall be eligible for appearing at the third semester examination of Second B.E. in that branch of study.

(b) Every candidate appearing for the third semester of second B.E. examination shall be required to show a competent knowledge of the subject as per examination and teaching scheme.

(c) A Candidate who has attended a regular course of study for the Fourth semester examination of second B.E. and has also appeared in the third semester examination of examination of second B.E. shall be eligible for appearing in the fourth semester examination of second B.E. in that branch of study.

(d) Every candidate appearing for the fourth semester of second B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

8. BE Third Year Examination:

(a) A candidate who after passing III & IV semester of second B.E. examination and has attended a regular courses of study in a particular branch of Engineering for the fifth semester examination of third B.E. in that branch of study.

(b) Every candidate appearing for the fifth semester of third B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

(c) A candidate who has attended regular courses of study for the eighth semester examination of final B.E. and also has appeared in V semester examination of the third B.E. shall be eligible for appearing in the eighth semester examination of final B.E. in that branch of study.

(d) Every candidate appearing for the eighth semester of final B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

9. BE Final Year Examination:

(a) A candidate who after passing V and VI semester of third B.E. examination and has attended regular courses of study in particular branch of Engineering for the seventh semester of final B.E. shall be eligible of appearing in the seventh semester examination of final B.E. in that branch of study.

(b) Every candidate appearing for the seventh semester of final B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

(c) A candidate who has attended regular course of study for the eighth semester of final B.E. and has also appeared in the seventh semester examination of final B.E. Shall be eligible for appearing at study.

(d) Every candidate appearing for the eighth semester of final B.E. examination shall be required to show a competent knowledge of the subjects as per examination and teaching scheme.

10. Training after BE Second year and BE Third year:

Every candidate is required to undergo practical training in a workshop, factory, mines or engineering works/design office approved by the Dean of the Faculty for a period as mentioned below:

(a) Building & Construction Technology after II and III Year	45+45=90 days
(b) Civil Engineering after II and III Year	45+45=90 days
(c) Chemical Engineering after II and III Year	45+45=90 days
(d) Computer Science & Engineering after II and III Year	45+45=90 days
(e) Electrical Engineering-after II and III Year	45+45=90 days
(f) Electronics & Comm. Engineering after II and III Year	45+45=90 days
(g) Electronics & Electrical Engineering after II and III Year	45+45=90 days
(h) Electronics & Computer Engineering after II and III Year	45+45=90 days
(i) Information Technology after II and III Year	45+45=90 days
(j) Mechanical Engineering after II and III Year	45+45=90 days
(k) Mining Engineering after II and III Year	45+45=90 days
(l) Production & Industrial Engineering after II and III Year	45+45=90 days

11. Criteria to Pass and Allowed To Keep Term (ATKT)

(a) The candidate has to pass individually in all subjects of each semester from I to VIII semesters, as mentioned in the specification of corresponding teaching and examination scheme.

(b) For a candidate to pass in each semester he/she must obtain:

For I and II semester examinations, if a candidate fails in not more than 3 units (excluding HUMANITIES & ENGLISH) in a semester examination, and for III to VII semester examinations, if a candidate fails in not more than 3 units in a semester examination, he/she shall be allowed to keep term (ATKT) in the next higher semester, subject to the provisions of clause 5(c),7(c),8(c), and 9(c). He/ She shall appear in the units(s) along with regular candidates whenever examination that semester is held and pass in the unit(s) in which he/she has failed. For the purpose of the clause, each written paper and each practical and sessional shall be counted as a separate unit. For I B.E. examination, candidates failing in HUMANITIES & ENGLISH shall be awarded an additional ATKT.

(c) To pass in III to VIII semester, a candidate should obtain at least 'P' grade in each theory paper, at least 'B' grade in each practical and sessionals and at least 5.0 SGPA (Semester Grade Point Average).

(d) A candidate who fails in three or less than three units (theory & practical) of the prescribed courses for him/her in that semester shall be ATKT in the next semester provided that he/she has secured the prescribed minimum SGPA. However he/she shall reappear and pass in the subjects in which he/she has failed, if any, in next regular examination of that semester. The course work marks obtained by him/her shall be carried over.

(e) If a candidate fails in more than three units (theory & practical) of the prescribed courses for him/her in that semester or doesn't secure prescribed minimum SGPA in that semester, he shall not be permitted to continue his studies in the next semester, and treated as an Ex-student, and he/she has to reappear in all theory papers, practicals and sessionals of that semester. All the marks obtained in course work, shall be carried over.

(f) A candidate who has passed all practicals and sessionals but failed in more than three theory papers of that semester shall appear in that semester examination as Ex-student in all theory papers. His practical & sessional and course work marks of the semester shall be carried over.

(g) A candidate, for clearing the course work for a subject must obtain at least **40%** marks in course work examination of that subject, failing which the candidate shall not be permitted to appear in final examination (ETE) of that subject in that semester. In other words, a candidate will be permitted to appear in end semester examination of those subjects only in which he/she has cleared the course work. Those candidates who have failed in the course work examination of a subject has to join as a regular student in the course whenever it is offered next by the department, based on the availability of resources and suitability of the candidate. The Head of the Department may organize and arrange special classes for the particular subject to minimize the loss to the student who fails in VIII semester. In case, the course is discontinued in the department, the student can take up, another course in lieu of the course discontinued, subject to approval of the Head of the Department.

(h) A candidate who fails in any elective subject may be permitted by the Head of the Department to change the elective subject in subsequent semester. He/she shall be required to undergo a regular course of study for the new elective subject.

(i) The candidates, who are permitted to appear as ex-students shall be required to pay a fee of Rs. 500/- or as amended from time to time for doing each practical and sessional during the semester.

NOTE: A candidate who is unable to appear at the semester examination in some/all written papers, Practical and sessionals due to any reason what so ever, shall be considered as having failed in those paper(s), Practical(s) and Sessional(s).

12. Change of Branch in Second Year:

A candidate, promoted to II year BE, may be permitted to change his/her branch of study, from GAS course to GAS Course and from SFS Course to SFS Course only, Strictly on the base of merit secured in BE I year examination (First and Second Semester Examination taken together) depending upon the vacancies available in a particular branch of study which shall be determined as follows.

"The maximum strength of branch should not increase by more than 10 percent of the sanctioned strength and the minimum strength of a branch should not be decreased to less than 90 percent of the sanctioned strength."

The sanctioned strength of a branch shall be reckoned to be the intake capacity of that branch, approved by AICTE.

13. Result Computation (Award of Grade and Grade Point Average)

(a) On the basis of percentage of obtained marks the process of result computation will be as follows, and followings will be awarded:

For every subject: Grade and Score Point
For every semester: Semester Grade Point Average (SGPA) up to precision of two digits after decimal.
For every semester: Cumulative Grade Point Average (CGPA) up to current semester, up to precision of two digits after decimal.

Step 1: For each subject the percentage of obtained marks will be converted into Grade as per Table I.

Table I: Percentage of Obtained Marks to Grade Conversion

Percentage of Obtained Marks in Theory Subjects	Percentage of Obtained Marks in Practical Subjects	Grade
85≤per	85≤per	O
70≤per<85	70≤per<85	A+
60≤per<70	60≤per<70	A
55≤per<60	55≤per<60	B+
50≤per<55	50≤per<55	B
45≤per<50	NA	C
35≤per<45	NA	P
per<35	per<50	F
Absent	Absent	AB

Step 2: For each subject convert the Grade to Score Point as per Table II.

Table II : Grade to Score Point

Grade	Score
O	10
A+	9
A	8
B+	7
B	6
C	5
P	4
F	0
AB	0

Step 3: Semester Grade Point Average (SGPA) of k^{th} semseter is

$$SGPA = \frac{\sum_{i=1}^{n} P_i * C_i}{\sum_{i=1}^{n} C_i}$$

Where P_i is Score Points in i^{th} subject, C_i is Credits of i^{th} subject, and n is total number of subjects in current k^{th} semester

Step 4: Cumulative Grade Point Average (CGPA) of k^{th} semester is

$$CGPA = \frac{\sum_{j=1}^{m} S_j * C_j}{\sum_{j=1}^{m} C_j}$$

Where S_j is SGPA of j^{th} semester, C_j is total Credits in j^{th} semester,
and m is total number of semesters upto current k^{th} semester.

(b) For determining merit position of the candidates at the final year level the SGPA obtained by them in III semester to VIII semester shall only be considered, termed as MGPA (Merit Grade Point Average). MGPA shall be calculated as below:

$$MGPA = \frac{\sum_{i=3}^{8} S_i * C_i}{\sum_{i=3}^{8} C_i}$$

Where S_i is SGPA of i^{th} semester, C_i is total Credits in i^{th} semester.

(c) In case a candidate passes any subject in 2^{nd} attempt or later one, the grade awarded shall not be higher than B+ in that subject.

(d) Awarded SGPA and CGPA shall be recalculated if a candidate passes a subject or all subjects of any semester in 2^{nd} or later attempt.

(e) To calculate SGPA and CGPA, obtained marks for all subjects shall be considered irrespective of whether it is F grade (Failed or Absent) or any other grade.

(f) Equivalent Division is mentioned below:

Table III : Division Equivalent of Grade Point Average		
Grade	**Score**	**Division**
O	10	Honours
A+	9	Honours
A	8	First
B+	7	Second
B	6	Second
C	5	Pass Class
P	4	Pass Class
F	0	Fail
AB	0	Absent

14. Requirement of additional degree:

(a) An engineering graduate of the Jai Narain Vyas University, Jodhpur, who wish to qualify for an additional degree of Engineering of the University will be considered by a committee consisting of the Dean and the Head of the Department concerned.

(b) He/She will be admitted in Second B.E. class of that branch. The written papers and practicals and sessionals which he/she has to appear at the various examinations in that branch will be decided by the above committee.

(c) He /She will be awarded Grades and Grade Points on the basis of percentage of marks obtained by applying result computation method mentioned in section 13.

(d) He/She has to undergo training after Second BE and Third BE as per Section 9.

(e) He/She will not be awarded any position in the class.

(f) Mention will be made in the certificate that he/she has qualified for the additional degree.

15. Medium of Instruction and Examination

The medium of Instructions and Examination in all Engineering Examinations of Theory/Practical and Sessional shall continue to be English as hitherto.

16. Make up Examination for VIII Semester:

(a) There shall be a Make up Examination for the VIII Semester only for those candidates, who are eligible for **ATKT in VIII semester**, at a suitable interval of time after declaration of the result of the VIII Semester Examination. Candidates, who fail or are unable to appear in this examination, shall appear in the immediate corresponding ensuring Semester Examination.

(b) Candidates who have failed in the Final B.E. Examination but have passed in seminar, project, practical training and tour, and obtained SGPA 5.00 or above in corresponding semester, shall be exempted from re-examination in project, practical training and tour and shall be required to pass the examination in rest of the subjects only.

(c) A candidate who passes in a limited number of Theory papers/Practical and Sessional /Project in VIII Semester Examination shall be awarded division with a mention of "Pass in more than one attempt" on the marksheet with asterisks on the respective Theory papers/ Practical and Sessional /Project.

17. On changing Teaching and Examination Scheme or contents of the offered subjects:

(a) In case a candidate fails in any semester, and appears as ex-student, he will be given two attempts to pass through OLD SCHEME. Otherwise he will be transferred to NEW SCHEME offered by the department currently.

(b) If a candidate joins any semester as regular student, in all cases he/she has to study as per the currently offered scheme.

(c) In case a candidate fails in some of the subjects in a semester (ATKT), he will be given only two chances to pass through OLD SCHEME. Otherwise he will be transferred to NEW SCHEME offered by the department currently.

18. For lateral entry candidates admitted to Second B.E. (all branches):

(a) The diploma passed candidates admitted in the Second B.E. (all branches) shall be required to undergo a regular course of study in Special Mathematics III and IV semesters of II B.E. along with other theory units of the semester examinations. For a candidate to pass in Special Mathematics examination the combined marks obtained in III & IV Semester shall be counted. Candidate failing in special mathematics shall be awarded one additional ATKT.

(b) The B Sc Passed candidates admitted to Second BE (all branches) will have to clear deficiencies of engineering subjects (theory and practical of B.E. Ist year) as mentioned below :-

Theory Papers	**Practicals and Sessionals**
CE 102 A : CIVIL ENGINEERING	CE 121B: ENGG. GRAPHICS
SE 104 A: ENGINEERING MECHANICS	SE 123 B : ENGINEERING MECHANICS LAB

EE 105 A: BASIC ELECTRICAL ENGINEERING
CSE 151 A : INTRODUCTION OF COMPUTING
ME 154 A : ELEMENTS OF MECHANICAL ENGINEERING
ECE 155 A : BASIC ELECTRONICS

CE 124 B: CIVIL ENGINEERING LAB
ME 125 B: WORKSHOP PRACTICE – I
EE 126 B: BASIC ELECTRICAL LAB

ME 171 B : MACHINE DRAWING
ME 173 B : MECHANICAL LAB
ME 175 B : WOTKSHOP PRACTICE - II
ECE 176 B : BASIC ELECTRONICS LAB
CSE 177 B : COMPUTER LAB

B.E. II YEAR (COMPUTER SCIENCE & ENGINEERING)
SEMESTER III EXAMINATION SCHEME- 2021

Branch Code	*Subject Code*	*Subject*	*Lecture*	*Tutorial*	*Practical*	*Contact Hours*	*Credits*	*Exam Hours*	*Marks*				
								ETE/PRE	*Theory*		*Practical*		*Total*
									CWS	*ETE*	*PRS*	*PRE*	
A: Written Papers													
MA	**201A**	**Advanced Engineering Mathematics -I (CSE/IT)**	**3**	**1**	**-**	**4**	**4**	**3**	**20**	**80**	**-**		**100**
CSE	211A	Discrete Structures (CSE/IT)	3	1	-	4	4	3	20	80	-		100
CSE	212A	Object Oriented Programming (CSE/IT)	3	1	-	4	4	3	20	80	-		100
CSE	**213A**	**Data Structures and Algorithms (CSE/IT)**	**3**	**1**	**-**	**4**	**4**	**3**	**20**	**80**	**-**		**100**
CSE	214A	Logic Design (CSE/IT)	2	1	-	3	3	3	20	80	-		100
CSE	**215A**	**Professional Practice, Cyber Law and Ethics (CSE/IT)**	**2**	**1**	**-**	**3**	**3**	**3**	**20**	**80**	**-**		**100**
Total (A)			**16**	**6**	**-**	**22**	**22**	**-**	**120**	**480**	**-**		**600**
B: Practical and Sessional													
CSE	212B	Object Oriented Programming Laboratory (CSE/IT)	-	-	2	2	1	3	-		50	50	100
CSE	213B	Data Structures and Algorithm Laboratory (CSE/IT)	-	-	2	2	1	3	-		50	50	100
CSE	214B	Logic Design Laboratory (CSE/IT)	-	-	2	2	1	3	-		50	50	100
CSE	216B	Python Programming Laboratory (CSE/IT)	-	-	2	2	1	3	-		50	50	100
TOTAL(B)			**-**	**-**	**8**	**8**	**4**	**-**	**-**		**200**	**200**	**400**
Grand Total (A+B)			**16**	**6**	**8**	**30**	**26**	**-**	**120**	**480**	**200**	**200**	**1000**

To pass, a candidate must obtain:
(a) 35 per cent in each written paper,
(b) 50 per cent in each of the practicals and sessionals
(c) 45 per cent in aggregate

CWS Class Work Sessional
ETE : End-Term Examination
PRS: Practical Sessional
PRE: Practical End-Term Examination

B.E. II YEAR (COMPUTER SCIENCE & ENGINEERING)
SEMESTER IV EXAMINATION SCHEME- 2021

Branch Code	*Subject Code*	*Subject*	*Lecture*	*Tutorial*	*Practical*	*Contact Hours*	*Credits*	*Exam Hours*	*Marks*				
								ETE/PRE	*Theory*		*Practical*		*Total*
									CWS	*ETE*	*PRS*	*PRE*	
A: Written Papers													
MA	**202A**	**Advanced Engineering Mathematics-II (CSE/IT)**	**3**	**1**	**-**	**4**	**4**	**3**	**20**	**80**	**-**		**100**
CSE	221A	Principles of Programming Languages (CSE/IT)	3	1	-	4	4	3	20	80	-		100
CSE	222A	Computer Organization and Architecture (CSE)	3	1	-	4	4	3	20	80	-		100
CSE	**223A**	**Database Management Systems (CSE/IT)**	**3**	**1**	**-**	**4**	**4**	**3**	**20**	**80**	**-**		**100**
CSE	**225A**	**Data Communications (CSE/IT)**	**3**	**1**	**-**	**4**	**4**	**3**	**20**	**80**	**-**		**100**
A		Open Elective-I (Open)	3	0	-	3	3	3	-	100			100
Total (A)			**18**	**5**	**-**	**23**	**23**	**-**	**100**	**500**	**-**		**600**
B: Practical and Sessional													
CSE	221B	Programming Language Laboratory (CSE/IT)	-	-	2	2	1	3	-		50	50	100
CSE	222B	Computer Organization & Architecture Laboratory (CSE)	-	-	2	2	1	3	-		50	50	100
CSE	**223B**	**Database Management Systems Laboratory (CSE/IT)**	**-**	**-**	**2**	**2**	**1**	**3**	**-**		**50**	**50**	**100**
CSE	226B	Unix/Linux Laboratory (CSE/IT)	-	-	2	2	1	3	-		50	50	100
TOTAL(B)			-	-	**8**	**8**	**4**	-	-		**200**	**200**	**400**
		Grand Total (A+B)	**18**	**5**	**8**	**31**	**27**	**-**	**100**	**500**	**200**	**200**	**1000**
C: Discipline& Extra-Curricular Activities													**100**

List of Open Electives I: Enclosed with examination scheme of VIII Semester

To pass, a candidate must obtain:

(a) 35 per cent in each written paper,
(b) 50 per cent in each of the practicals and sessionals
(c) 45 per cent in aggregate

CWS	Class Work Sessional	**PRS**: Practical Sessional	
ETE	: End-Term Examination	**PRE**: Practical End-Term Examination	

#Three MTEs will be conducted in a semester and best 2 out of 3 will be considered.

B.E. III YEAR (COMPUTER SCIENCE & ENGINEERING)
SEMESTER V EXAMINATION SCHEME- 2022

Branch Code	*Subject Code*	*Subject*	*Lecture*	*Tutorial*	*Practical*	*Contact Hours*	*Credits*	*Exam Hours*	*Marks*				
								ETE/PRE	*Theory*		*Practical*		*Total*
									CWS	*ETE*	*PRS*	*PRE*	
A: Written Papers													
CSE	311A	Theory of Computation (CSE/IT)	3	1	-	4	4	3	20	80	-		100
CSE	**312A**	**Design & Analysis of Algorithms (CSE/IT)**	**3**	**1**	**-**	**4**	**4**	**3**	**20**	**80**	**-**		**100**
CSE	313A	System Software and Operating System (CSE/IT)	3	1	-	4	4	3	20	80	-		100
CSE	314A	Microprocessors (CSE)	3	1	-	4	4	3	20	80	-		100
CSE	**315A**	**Computer Networks (CSE/IT)**	**3**	**1**	**-**	**4**	**4**	**3**	20	80	-		100
		Open Elective -II	3	0	-	3	3	3	-	100	-		100
Total (A)			**18**	**5**	**-**	**23**	**23**	**-**	**100**	**500**	**-**		**600**
B: Practical and Sessional													
CSE	**312B**	**Design & Analysis of Algorithm Laboratory (CSE/IT)**	**-**	**-**	**2**	**2**	**1**	**3**	**-**		**50**	**50**	**100**
CSE	313B	System Software and Operating System Laboratory (CSE/IT)	-	-	2	2	1	3	-		50	50	100
CSE	314B	Microprocessors Laboratory (CSE)	-	-	2	2	1	3	-		50	50	100
CSE	315B	Computer Networks Laboratory (CSE/IT)	-	-	2	2	1	3	-		50	50	100
TOTAL(B)			-	-	**8**	**8**	**4**	-	-		**200**	**200**	**400**
		Grand Total (A+B)	**18**	**5**	**8**	**31**	**27**	**-**	**100**	**500**	**200**	**200**	**1000**

To pass, a candidate must obtain:
(a) 35 per cent in each written paper,
(b) 50 per cent in each of the practicals and sessionals
(c) 45 per cent in aggregate

CWS Class Work Sessional
ETE : End-Term Examination
PRS: Practical Sessional
PRE: Practical End-Term Examination

B.E. III YEAR (COMPUTER SCIENCE & ENGINEERING)
SEMESTER VI EXAMINATION SCHEME- 2022

Branch Code	*Subject Code*	*Subject*	*Lecture*	*Tutorial*	*Practical*	*Contact Hours*	*Credits*	*Exam Hours*	*Marks*				
								ETE/PRE	*Theory*		*Practical*		*Total*
									CWS	*ETE*	*PRS*	*PRE*	
A: Written Papers													
CSE	**321A**	**Visual Computing (CSE)**	**3**	**0**	**-**	**3**	**3**	**3**	**20**	**80**	**-**		**100**
CSE	**322A**	**Modern Application Development (CSE/IT)**	**3**	**1**	**-**	**4**	**4**	**3**	**20**	**80**	**-**		**100**
CSE	323A	Java Programming (CSE/IT)	3	0	-	3	3	3	20	80	-		100
CSE	**324A**	**Artificial Intelligence and Machine Learning(CSE/IT)**	**3**	**1**	**-**	**4**	**4**	**3**	**20**	**80**	**-**		**100**
CSE	325A	Principle of Compiler Design (CSE/IT)	3	1	-	4	4	3	20	80	-		100
		Open Elective-III	3	0	-	3	3	3	00	100	-		100
TOTAL(A)			**18**	**3**	**-**	**21**	**21**	**-**	**100**	**500**	**-**		**600**
B: Practical and Sessional													
CSE	**321B**	**Visual Computing Laboratory (CSE)**	**-**	**-**	**2**	**2**	**1**	**3**	**-**		**50**	**50**	**100**
CSE	**322B**	**Modern Application Development Laboratory (CSE/IT)**	**-**	**-**	**2**	**2**	**1**	**3**	**-**		**50**	**50**	**100**
CSE	323B	Minor Project Laboratory(CSE/IT)	-	-	2	2	1	3	-		50	50	100
CSE	324B	Artificial Intelligence Laboratory (CSE/IT)	-	-	2	2	1	3	-		50	50	100
CSE	325B	Compiler Design Laboratory (CSE/IT)	-	-	2	2	1	3			50	50	100
TOTAL(B)			**-**	**-**	**10**	**10**	**5**	-	-		**250**	**250**	**500**
Grand Total (A			**18**	**3**	**10**	**31**	**26**	**-**	**100**	**500**	**250**	**250**	**1100**
C: Discipline& Extra-Curricular Activities													**100**

List of Open Electives III: Enclosed with examination scheme of VIII Semester

To pass, a candidate must obtain:

(a) 35 per cent in each written paper,
(b) 50 per cent in each of the practicals and sessionals
(c) 45 per cent in aggregate

CWS	Class Work Sessional	**PRS**: Practical Sessional	
ETE	: End-Term Examination	**PRE**: Practical End-Term Examination	

B.E. IV YEAR (COMPUTER SCIENCE & ENGINEERING)
SEMESTER VII EXAMINATION SCHEME- 2023

Branch Code	*Subject Code*	*Subject*	*Lecture*	*Tutorial*	*Practical*	*Contact Hours*	*Credits*	*Exam Hours*	*Marks*				
									Theory		*Practical*		*Total*
								ETE/PRE	*CWS*	*ETE*	*PRS*	*PRE*	
A: Written Papers													
CSE	**411A**	**Cryptography & Security (CSE/IT)**	**3**	**1**	**-**	**4**	**4**	**3**	**20**	**80**	**-**		**100**
CSE	412A	Data Science Analytics (CSE)	3	1	-	4	4	3	20	80	-		100
CSE	413A	Software Engineering (CSE/IT)	3	1	-	4	4	3	20	80	-		100
CSE	414A	Robotics & Embedded System (CSE/IT)	3	1	-	4	4	3	20	80	-		100
A		Elective – I	3	1	-	4	4	3	20	80	-		100
TOTAL(A)			**15**	**5**	**-**	**20**	**20**	**-**	**100**	**400**	**-**		**500**
B: Practical and Sessional													
CSE	412B	Data Science Analytics Laboratory (CSE)	-	-	2	2	1	3	-		50	50	100
CSE	413B	Software Engineering Laboratory (CSE/IT)	-	-	2	2	1	3	-		50	50	100
CSE	414B	Robotics & Embedded System (CSE/IT)	-	-	2	2	1	3	-		50	50	100
B		Elective – I Laboratory	-	-	2	2	1	3	-		50	50	100
CSE	415D	Seminar	-	-	2	2	1				50	50	100
TOTAL(B)			-	-	**10**	**10**	**5**	-	-		**250**	**250**	**500**
		Grand Total (A+B)	**15**	**5**	**10**	**30**	**25**	**-**	**100**	**400**	**500**		**1000**

List of Electives I:

CSE 451A – Soft Computing (CSE)
CSE 452A – Image Processing (CSE/IT)
CSE 453A – Client-Server Technology (CSE/IT)
CSE 454A – Multimedia Technology (CSE/IT)
CSE 457A – Digital Signal Processing (CSE/IT)

CWS Class Work Sessional
ETE : End-Term Examination
PRS: Practical Sessional
PRE: Practical End-Term Examination

To pass, a candidate must obtain:

(a) 35 per cent in each written paper,
(b) 50 per cent in each of the practicals and sessionals
(c) 45 per cent in aggregate

B.E. IV YEAR (COMPUTER SCIENCE & ENGINEERING)
SEMESTER VIII EXAMINATION SCHEME- 2023

Branch Code	*Subject Code*	*Subject*	*Lecture*	*Tutorial*	*Practical*	*Contact Hours*	*Credits*	*Exam Hours*	*Marks*				
								ETE/PRE	*Theory*		*Practical*		*Total*
									CWS	*ETE*	*PRS*	*PRE*	
A: Written Papers													
CSE	**421A**	**Internet of Things (CSE)**	**3**	**1**	**-**	**4**	**4**	**3**	**20**	**80**	**-**		**100**
CSE	**422A**	**Cloud Computing (CSE)**	**3**	**1**	**-**	**4**	**4**	**3**	**20**	**80**	**-**		**100**
A		Elective – II	3	1	-	4	4	3	20	80	-		100
A		Elective – III	3	1	-	4	4	3	20	80	-		100
		Total (A)	**12**	**4**	**-**	**16**	**16**	**-**	**80**	**320**	**-**		**400**
B: Practical and Sessional													
CSE	**421 B**	**Internet of Things Laboratory** (CSE)	-	-	**2**	**2**	**1**	**3**	-		50	50	100
CSE	**422B**	**Cloud Computing Laboratory (CSE)**	**-**	**-**	**2**	**2**	**1**	**3**	**-**		**50**	**50**	**100**
CSE	B	Elective –II Laboratory	-	-	2	2	1	3	-		50	50	100
CSE	B	Elective – III Laboratory	-	-	2	2	1	3			50	50	100
CSE	429D	Project (CSE)	-	-	6	6	3	3			100	100	200
CSE	435C	Practical Training	-	-	-	-	2	3	-		50	50	100
TOTAL(B)			**-**	**-**	14	14	9	-	-		**350**	**350**	**700**
		Grand Total (A+B)	**12**	**4**	14	**30**	**25**	**-**	**80**	**320**	**350**	**350**	**1100**
C: Discipline& Extra-Curricular Activities													**100**

List of Elective – II
CSE 461A – Intelligence Database System (CSE/IT)
CSE 462A – Object Oriented DBMS (CSE/IT)
CSE 463A – Object Oriented Software Engineering (CSE/IT)
CSE 464A – Real Time Systems (CSE)
CSE 466A – Graph Theory (CSE/IT)
CSE 455A – Computer Vision (CSE)

List of Elective – III
CSE 465A – Information Theory & Coding (CSE/IT)
CSE 467A – Simulation and Modeling (CSE)
CSE 468A – Mobile Computing (CSE/IT)
CSE 469A - Bioinformatics (CSE/IT)
CSE 471A -Block Chain(CSE/IT)
CSE 472A -Advanced Computer Architecture(CSE)

To pass, a candidate must obtain:
(a) 35 per cent in each written paper,
(b) 50 per cent in each of the practicals and sessionals
(c) 45 per cent in aggregate

CWS	Class Work Sessional	**PRS**: Practical Sessional
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List of Open Electives	
Name of subject	**Semester**
BCT 291 A Open Elective-I: Sustainable Architecture CE 291A Open Elective-I :Energy Efficient Building Design ChE 291 A Open Elective-I : Renewable Energy Sources EE 291 A Open Elective-I : Industrial Applications of Electrical Drives EE 292 A Open Elective-II: Engineering Economics Ma 291 A Open Elective-I :Mathematical Statistics For Engineers ME 291 A Open Elective-I:Renewable Energy Sources ME 292A Open Elective-I: Automobile Engineering MI 291A Open Elective-I: Tunneling For Engineering Projects PI 291A Open Elective-I: Manufacturing Science	Fourth Semester
BCT 341 A Open Elective-II: Traditional Indian Architecture CE 341A Open Elective-II: Non Urban Public Hygiene & Drinking Water ChE 341 A Open Elective-II : Petroleum Refining Technology EE 341 A Open Elective-II : Optimization Techniques Ma 341 A Open Elective-II :Mathematical Theory of Operations Research ME 341A Open Elective-II : Economics Analysis and Management of Operations ME 342A Open Elective-II: Systems Design And Analysis MI 341A Open Elective-II: Application of GIS & Remote Sensing in Engineering PI 341A Open Elective-II: Principles of Management & Economics SE 341A Open Elective-II :Structural Dynamics	Fifth Semester
BCT 391 A Open Elective-III: Climate Responsive Architecture CE 391A Open Elective-III: Ecosystem & Biodiversity ChE 391 A Open Elective-III : Nanotechnology EC 391 A Open Elective-III: Electronic Instrumentation EE 391 A Open Elective-III: Soft Computing Techniques EE 392 A Open Elective-III: Energy Conservation Ma 391 A Open Elective-III: Advanced Numerical Analysis ME 391A Open Elective-III: Design Planning And Control Of Production System ME 392A Open Elective-III: Finite Elements Method MI 391A Open Elective-III: Project Environment Clearance PI 391A Open Elective-III: Quality Management SE 391A Open Elective-III :Finite Element Method	Sixth Semester
BCT: Building Construction Technology, CE: Civil Engineering, ChE: Chemical Engineering, CSE: Computer Science and Engineering, EC: Electronics & Communication, EE: Electrical Engineering, ME: Mechanical Engineering, MI: Mining Engineering, PI: Production & Industrial Engineering, SE: Structural Engineering, Ma: Mathematics	

THIRD SEMESTER (CSE)

Ma 201 A – Advanced Engineering Mathematics – I (CSE/IT)

3L,1T **3 Hours, 80 Marks**

Section A

Differential equations: Simultaneous differential equations, Total differential equations, Partial differential equations of first order, Charpit's method, Linear partial differential equations with constant coefficients.

Linear algebra: Binary operations on set, definitions and examples of group, ring, field and vector spaces. Algebra of matrices, symmetric and skew symmetric matrices, inverse and rank of a matrix, solution of system of linear equations, orthogonal matrices. Hermitian, skew Hermitian and unitary matrices, diagonalization of matrices. Eigen values and Eigen vectors.

Section B

Statistical methods: frequency distribution, measures of central tendency: mean, mode, median. Quartiles, deciles, percentiles. Measures of dispersion: mean deviation, standard deviation, variance, absolute and relative dispersion, coefficient of variation. Moments for grouped data, relations between moments, computations of skewness and kurtosis. Correlation and Regression analysis of two parameters

Probability : Theorems of probability and their application, Binomial, Poisson and Normal probability distributions and their properties.

Note: Candidates are required to attempt FIVE questions in all, selecting at least two from each Section.

CSE 211 A - DISCRETE STRUCTURES (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Introduction to Discrete Mathematical Structures, Formal Methods: Induction and Analogy, Abstraction.
Sets, sequences, empty set, power set, operations on sets, Venn diagram, ordered pair, principle of inclusion and exclusion. Counting and Combinatorics.

Introduction to mathematical logic, statements and notations, well-formed formulas, tautologies, tautological implications, normal forms, the theory of Inference for statement calculus, predicate logic.

Graph Terminology, Degrees of Nodes, Isomorphic Graphs, Dijkstra's Shortest Path Algorithm, Planar Graphs, Eulerian Graphs, Hamiltonian Graphs, Traveling Salesman Problem.

Trees, Introduction, Rooted and Other Trees, Representation of Prefix Codes, representation of Arithmetic Expression, Representation of Prefix Codes, Spanning Trees, Traversing Binary Trees, Binary Search Trees.

Relations, matrix and graph representation of relation, properties of relations, partitions. Equivalence Relations, Compatibility Relations, Composition of Binary Relations, Transitive and symmetric closures, partially ordered set, lattices. Recurrence relations.

Functions, Matrix representation of functions, composition of function, inverse function.

Algebraic Structures, General properties of algebraic systems, groupoids, semigroup, monoids, group, rings. Applications of algebra to control structure of a program. Homomorphism, congruences, admissible partitions. Groups and their graphs.

CSE 212 A - OBJECT ORIENTED PROGRAMMING (CSE/IT)

3L,1T **3 Hours, 80 Marks**

A review of C. Concepts of object oriented programming using C++. Data types: elementary and derived data types, literals.
Operators and expressions: operators, association and precedence rules of operators, expressions using unary, binary and ternary operators.
Statements: declarations as statements, selection statements, iteration statements, goto statement, break statement, continue statement, return statement, try-catch block.
Functions: void functions, functions with return value, call by value and call by reference parameter passing, default parameters, recursive functions, inline functions.
Classes: classes, objects, friend functions, classes within a class, local classes, global classes, constructors, destructors.
Derived classes: single and multiple derivation of classes, multilevel and hybrid derivation of classes, constructors, destructors.
Polymorphism: function and operator overloading, virtual functions.
Streams: input and output of built-in data types, manipulators.
File streams: opening a file, accessing a file, closing a file.
Exceptions: catching exceptions, rethrowing the exception, standard exceptions.
Templates: defining a template, template instantiation, function templates, class templates.
Elementary case study of a object oriented database in C++.

CSE 213 A - DATA STRUCTURES AND ALGORITHMS (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Introduction to Data Structures: Need of data structures, Primitive and Non-primitive data structures. Linear Data Structures – Arrays, Multidimensional arrays, Storing arrays in memory, applications. Time and space complexity of the algorithms–Big-O,θ,Ω, and little-o & Ω, Asymptotic complexity, Upper and Lower bound time and space tradeoffs.

Stacks - Basic Operations, Representation using Static and Dynamic arrays, Multiple stack implementation using single array, Applications of stack: Recursion, Reversing lists, Factorial Calculation, Infix to postfix Transformation, Evaluating Arithmetic Expressions and Towers of Hanoi. Queues: Basic Operations, Representation using arrays, Applications - Round Robin Algorithm. Circular Queues, DeQueue, Priority Queues.

Linked Lists - Representation of linked lists in memory, Operations on a Single linked list, Reversing, Advantages and Disadvantages of single linked list, circular linked list, double linked list. Searching Techniques - Sequential and binary search. Sorting Techniques - Basic concepts, Bubble Sort, Insertion sort, Selection sort, Quick sort, Heap sort, Merge sort and Radix sort.

Trees - Definition of tree, Properties of tree, Binary Tree, Representation of Binary trees using arrays and linked lists, Operations on a Binary Tree, Binary Tree Traversals (recursive), Binary search tree, B-tree, AVL tree, Threaded binary tree.

Graphs - Basic concepts, Different representations of Graphs, Graph Traversals (BFS & DFS), Minimum Spanning Tree (Prims & Kruskal, Dijkstra's shortest path algorithms. Hashing: Hash function, Address calculation techniques, Common hashing functions, Collision resolution: Linear and Quadratic probing, Double hashing.

EC 214 A - LOGIC DESIGN (CSE/IT)

2L, 1T **3 Hours, 80 Marks**

Introduction to number systems, concept of logic gates, boolean algebra and simplification of boolean expressions, K-map, tabular method, combinational circuits, half adder, full adder, flip flops, transfer circuits, clocks, shift registers and binary and BCD counters.

Multiplexer, demultiplexer, encoder, decoder.

Analysis and design of synchronous sequential systems, finite memory and flow chart method of design, State assignment, races and hazards, Introduction to threshold logic & relay circuits, sequential adder.

Introduction to switching devices, positive and negative logic. OR, AND, NOR, NAND, Exclusive OR and Exclusive NOR gates, RTL, DCL, DCTL, TTL, RCTL, ECL, HTL, MOS AND CMOS logic circuit and their realization. Fan-in and Fan-out capacity. Speed and delay in logic circuit.

CSE 215 A – PROFESSIONAL PRACTICE, CYBER LAW AND ETHICS (CSE/IT)

2L, 1T **3 Hours, 80 Marks**

Introduction to Professional Practice. Graduate Attributes, Expectations and Program Educational Objectives. Introduction to Professional Bodies & Societies – IEEE, ACM, CSI, IEI, Cert-IN, MeiTy, DST (Central & State), NASSCOM etc. Corporate Career vs Entrepreneurship.

Concept of Ethics, Values and Morality. Concept of Harmony, Co-Existence and Social Responsibility. Ethical Conflicts and Case Studies. Ethics for Students – Discipline, Plagiarism, Responsibilities, Safety, Bias & Discrimination, Harassment. Ethics for Innovation, Peer Learning and Productivity. Sustainable Development and Environmental Ethics. Concept of 5Rs. Ethics for Software Professionals – ACM/IEEE Software Engineering Code of Ethics and Professional Practice.

Professional Practices – Concept and Case studies for Ego Management, Leadership, Sharing of Resources, Confidentiality, Privacy and Digital Divide at work. Work Etiquettes for In-person meetings, Virtual Communications (Audio, Video & Emails), Social Media, Body Language and Corporate Dining. International Etiquettes – Language, Timezones, Holidays & Customs.

Industry Practices – Case studies on Corporate Structure, Values, Policies and Employee Code of Conduct. Introduction to Software Documentation & Contracts. Proprietary & Open Source Licensing Models. Basics of Software Requirements, Quality, Version Control and Risk Management. Introduction to ISO/IEC/IEEE 12207, IEEE 830-1998, CMMI and Six Sigma. Lifelong Learning for CS professionals – Need, Resources and Approaches. Introduction to Compliance Audits – ISO 27001, CISSP and CISSA.

Cyber Laws - Cybercrimes and Cyber security, Need of Cyber laws, The Indian IT Act, 2000 and its amendments. Challenges to Indian Law and Cybercrime Scenario in India. Intellectual Property Rights – Patents, Trademarks,

Trade Secrets, Designs, Copyrights. Breach of IPR and remedies. Data Protection Laws in India. Case Studies on IPR and Cybercrime lawsuits.

CSE 216B – PYTHON PROGRAMMING LABORATORY (CSE/IT)

2P **50 Marks**

Introduction to Python, Python Data Types, Python Operators and Operands, Python Program Flow Control, Python Functions, Modules and Packages Organizing python codes using functions, Organizing python projects into modules, Importing own module as well as external modules, understanding Packages Powerful Lamda Function in Python programming using Functions, modules and external packages.

Python File Operations.

FOURTH SEMESTER

Ma 202 A – Advanced Engineering Mathematics – II (CSE/IT)

3L,1T **3 Hours, 80 Marks**

Section A

Transforms: Laplace Transform, Inverse Laplace Transform, Properties of Laplace Transforms, Application of Laplace Transform to solve differential equation with constant coefficients and simultaneous linear differential equations.
Special function: Series solution of Bessel and Legendre's differential equations. Generating function of Bessel and Legendre's Polynomials. Orthogonal Property of Bessel and Legendre's function. Rodrigue's formula. Recurrence relations of Bessel and Legendre's polynomials.

Section B

Numerical Analysis: Interpolation with equal intervals: Newton-Gregory interpolation formulae, Lagrange's, interpolation formula for unequal intervals. Central difference interpolation formulae: Gauss' forward and backward formulae, Stirling's and Bessel's interpolation formulae. Numerical integration: Trapezoidal rule, Simpson' s 1/3 and 3/8 rule. Numerical solution of algebraic and transcendental equations: Bisection, regula falsi and Newton-Raphson methods. Numerical solution of linear simultaneous equations: Gauss' elimination, Gauss-Jordon, Jacobi and Gauss-Siedal methods. Numerical solution of ordinary differential equations: Euler's, Runge-Kutta Fourth order and Milne's methods. Numerical eigen value and eigen vector: Power method, Givin's method.

Note: Candidates are required to attempt FIVE questions in all, selecting at least two from each Section.

CSE 221 A - PRINCIPLES OF PROGRAMMING LANGUAGES (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Importance of programming languages, brief history , features of good programming language. Translators, Syntax, semantics, virtual computers. Binding and binding time.

Elementary and structured data types, their specifications and implementation. Type checking and type conversion, vectors arrays, records, character string, variable size data structures. Sets, input and output files.

Evolution of the concept of data type, abstraction, encapsulation and information binding, subprograms, type definition and abstract data types.

Implicit and explicit sequence control, sequence control within expression and between statements. Subprogram sequence control, Recursive subprograms, Exception and exception handlers, Coroutines and scheduled subprograms. Task and concurrency exception.

Names and referencing environments, Static, dynamic and block structure, Local data and local referencing environments.

Dynamic and static scope of shared data, Block structure, parameters and their transmission. Tasks and shared data. Storage requirement for major run-time elements. Program and system controlled storage management. Static and stack-based storage management. Fixed size and variable-size heap storage management.

CSE 222 A –COMPUTER ORGANIZATION AND ARCHITECTURE (CSE)

3L, 1T **3 Hours, 80 Marks**

Organization of computer system, Basic Building blocks of CPU-ALU, Timing and Control Unit, Construction of ALU, integer representation, binary half and full adder. Parallel full adder. Addition and subtraction in a Parallel arithmetic element. BCD adder. Binary multiplication, Booth's algorithm. Binary division. Logical operations, implementation of logical instructions, floating point number system, and arithmetic operations on floating point numbers.

General instruction formats, addressing modes.

Concept of control unit, execution of instructions, Hardwired and Microprogrammed control unit, Microinstructions, Horizontal and vertical format, Microprogramming, Wilkes control .

Memory element , RAM, Static RAM, Dynamic RAM, dimension of memory access, ROM, PROM, EPROM, EEPROM, Magnetic, CCD and cache memories. Hierarchy of memories. Associative memory.

Interconnection of computer components, buses, bus formats and operations, isolated and memory-mapped input-output, interfacing of keyboards and printers. Interrupts in IO systems, DMA. Data transfer, DMA interrupts, polling, masking, nested interrupts. Control of data transfer, handshaking, bus scheduling, standard bus interfaces.
Introduction to printers, magnetic tapes, disks, floppy disks, optical disk.

CSE 223 A – DATABASE MANAGEMENT SYSTEM (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Overview and History of DBMS. File System v/s DBMS. Advantages of DBMS Describing and Storing Data in a DBMS. Queries in DBMS. Structure of a DBMS. Types of Databases. Comparison between RDBMS and OODBMS.

Entity Relationship model: Overview of Entities, Attributes and Relationships. Features of the ER Model- Sets, Constraints & Hierarchies. Data Design with ER Model. Relational Algebra and Tuple Calculus – Selection, Projection, Set Operations, Renaming, Joints, Division, Relation Calculus, Expressive Power of Algebra and Calculus.

Structures Query Language: Union, Intersection, Except, Nested Queries, Set-Comparison, Aggregate Operators, Null Values. Join Queries, Group & Order Clauses. Key Constraints in SQL, Views & Triggers. Introduction to ODBC and JDBC.

Schema & Normalization - Introduction to Schema, Functional Dependencies, Relational Normal Forms, Need for Normalization, Decomposition into BCNF and 3-NF. Transactions: Transaction Concept, Transaction States, Atomicity, Consistency, Isolation & Durability.

Concurrency Control - Concurrent Executions, Serializability, Lock-Based Protocols, Timestamp-Based Protocols, Deadlock Handling. Database Failures – Introduction and Recovery Schemes. Shadow Paging and Log-based Recovery. Recovery with Concurrent transactions.

Storage and Indexing – Concepts. Organization of Records, Data-Dictionary Storage, Column-Oriented Storage. Ordered Indices, Hash Indices & Bitmap Indices. B-Trees and B+ Trees. Security and Integrity – Authorization, Security Specification in SQL, Encryption and Statistics in databases. Introduction to relational, distributed, centralized and object-oriented databases.

CSE 225A – DATA COMMUNICATIONS (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Overview and Architecture of Communication Systems. Basic Communication Model. Need and Advantages of Data Communications. Analog and Digital Signals - Periodic and Nonperiodic, Time and Frequency Domains, Concept of Bandwidth, Bit rate, Bit Length.

Digital Communication - Transmission of Digital Signals, Transmission Impairments, Date Rate Limits, Nyquist Bit Rate, Noisy Channel - Shannon Capacity, Performance – Bandwidth, Throughput, Latency, Bandwidth-Delay, Jitter. Digital-To-Digital Conversion, Analog-To-Digital Conversion, Digital-To-Analog Conversion, Analog-To-Analog Conversion.

Data Transmission – Transmission Modes, Multiplexing, FDM, TDM, WDM. Spread Spectrum - FHSS, DSSS. Transmission Media - Twisted-Pair, Coaxial Cable, Fiber-Optic. Unguided Media – Wireless, Radio, Microwave and Infrared. Introduction to telecommunication networks – Simplex, Duplex and Half-Duplex lines.

Introduction to Computer Networks, Types of Networks, Standards, Protocol Layers. The OSI Model. Introduction to Switching – Circuit and Packet Switching. Error Detection and Correction - Block coding, Cyclic codes, Checksum, Forward error correction.

Data link control: DLC services, Framing, Flow and error control, Data link layer addressing and protocols, HDLC and P2P. Media Access control: Random Access, Controlled Access and Channelization. Wired LANs and Ethernet Protocol, Overview of Radio-wave Propagation, Optical and Satellite Communications.

CSE 226B: UNIX/LINUX LABORATORY (CSE/IT)

2P **50 Marks**

Installation of Unix/Linux operating system. Study of logging/logout details. Study of Unix/Linux general purpose utility command list obtained from (man, who, cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout) commands. Study of vi editor. Study of Bash shell, Bourne shell and C shell in Unix/Linux operating system. Study of Unix/Linux file system (tree structure). Study of .bashrc, /etc/bashrc and Environment variables. Shell script programming, sed command, grep, awk, perl scripts. Different debug option (verbose, trace, xtrace).

FIFTH SEMESTER

CSE 311 A – THEORY OF COMPUTATION (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Finite Automata & Regular Expression: Basic Concepts of finite state machine. Deterministic and Non-deterministic finite automata. Conversion of NDFA to DFA, NFAs with epsilon transitions. Design regular expressions. Relationship between regular expression & Finite automata. Minimization of finite automata. Finite automata with output: Mealy & Moore Machines.

Regular Set and Regular Grammar: Formal definition of Regular Language and Grammar. Regular Sets and Regular Grammars. Equivalence of regular grammar and finite automata. Kleen's closure Theorem. Arden's Theorem. Closure properties of Regular language. Pumping lemma for Regular language. Myhill-Nerode theorem.

Context Free Grammar/ Language & Pushdown Automata: Context Free Grammars. Derivations, Parse trees, Ambiguity. Greiback Normal form, Chomsky normal forms. Pushdown Automata: Definitions, Instantaneous descriptions, Deterministic pushdown automata, Non-deterministic Pushdown automata. Context Free Language. Closure properties of CFLs. Pumping lemma for CFL.

Linear bounded Automata & Context Sensitive Language: Chomsky Hierarchy of Languages and automata, Introduction to Linear bounded Automata, Instantaneous descriptions. Properties of context-sensitive languages. Context sensitive grammar.

Turing Machine: Definition of Turing machine, Instantaneous descriptions. Design of TM, Other Turing Machine Models. Recursive language and Recursively enumerable languages. Computability. Universal Turing Machines, Church-Turing Thesis, Halting Problem, Reductions and Undecidability Proofs. Rice's Theorem.

CSE 312A - DESIGN AND ANALYSIS OF ALGORITHMS (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Review of Algorithm and its specification, performance analysis and Randomized Algorithms. Random access machines (RAM), computational complexity of RAM program. Time and Space complexity, Asymptotic notations (Big-O,θ,Ω, and little-o & Ω). Complexity estimation using Substitution method, Recursion trees and Master Method.

Design of Efficient Algorithms: *Divide and conquer*: Binary Search, finding maximum and minimum, Merge Sort, Quick Sort, Matrix Multiplication, Convex Hull. *Greedy methods*: Knapsack problem, tree vertex splitting, Minimum Spanning Trees – Prim's and Kruskal's Algorithms, Optimal Reliability Allocation, Knapsack, Single Source Shortest Paths – Dijkstra's and Bellman Ford Algorithms.

Design of Efficient Algorithms: *Dynamic programming:* Matrix Chain Multiplication, Longest Common Subsequence, Multi Stage Graph and 0/1 Knapsack Problem, all Pair Shortest Paths – Warshal's and Floyd's Algorithms, Resource Allocation Problem. Backtracking, *Branch and Bound:* Traveling Salesman Problem and Lower Bound Theory, Graph Coloring, n-Queen Problem and Hamiltonian Cycles.

Comparative study of Sorting Algorithms - Radix sort, Heap sort, Merge sort, Quick sort and Topological Sort. Order statistics and expected time for order statistics. Advanced Trees - Definitions, Operations on Weight Balanced Trees, Huffman Trees, 2-3 Trees and Red- Black Trees.

Graph Theory Algorithms - Algorithms for Connectedness, finding all Spanning Trees in a Weighted Graph and Planarity Testing, Breadth First and Depth First Search, Vertex cover problem. Polynomial Time Solvable problems, Reductions and Completeness, Definition and Interpretation of NP-Completeness, The P vs. NP, Algorithmic Approaches to NP-Complete Problems.

CSE 313 A - SYSTEM SOFTWARE AND OPERATING SYSTEM (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Overview of System Architecture. Types and Goals of System Software. Hierarchy of Programming Languages. Design of an Assembler – Functions, Data Structures and Algorithms. Introduction to Loaders & Linkers – Absolute loaders, Bootstrap loaders, Library Search & Linkage Editors. Dynamic & Static Linking.

Operating Systems: Overview, Structure and Services, System Calls. Programs, Process and Threads. Process Life Cycle. Operations on Processes. User mode & Kernel Mode Programs.

Process Management: Process Scheduling – Objectives & Algorithms. Inter Process Communication. Process Synchronization – Critical Section Problem, S/W & H/W Approaches. Peterson's Solution. Semaphores, Monitors. Classical Problems.

Deadlock: Overview, Characteristics, Prevention, Avoidance, Detection and Recovery.

Memory Management: Address Spaces – Logical and Physical. Contiguous & Non-Contiguous Allocation, Fragmentation. Swapping, Paging, Segmentation. Virtual Memory – Demand Paging, Page Replacement Algorithms, Thrashing.

File Concepts & File Systems: Directory Structure, Access Methods, File Protection. Disk Scheduling Algorithms. Input/Output: Polling, Interrupt Driven, Direct Memory Access. Security and Authentication in OS.

CSE 314A - MICROPROCESSORS (CSE)

3L, 1T **3 Hours, 80 Marks**

An introduction to 80x86 microprocessor family, Real and Protected mode Operation, S/W model of 80x86 family, processor registers, data organization, Instruction types, addressing modes, interrupts, a comparative study of 8086, 80286, 80386, and Pentium.

Software Architecture, Addressing modes, Flags, Data transfer and string instructions, arithmetic, logical, bit manipulation, program transfer and processor control instructions.

Use of assembler directives, Using macros, instruction execution time, Interrupt Processing, working with interrupt vectors, Use of BIOS and DOS function calls, using disks and files.

Protected mode operation, Segmentation, Paging, Protection, Multitasking, Exceptions, Virtual- 8086 mode, Protected mode applications,An introduction to supporting chips and interfacing - 8255, 8279,8253, 8259, 8257 (their advanced versions). Interfacing assembly with C- language.

CSE 315A- COMPUTER NETWORKS (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Overview of Network topologies and OSI reference model. TCP/IP Protocol Suite. Layers in TCP/IP. Network Devices – Switch, Hub, Router, Gateway. Overview of Physical Layer and Data Link Layer.

Network Layer – Packets, Connectionless and Connection-Oriented protocols services. Introduction to IPv4 & IPv6. IPV4 Addressing, Forwarding of Packets. Routing algorithms. Performance – Delay, Throughput, Packet Loss, Congestion. Datagrams & Fragmentation. OSPF & BGP. Introduction to Multicasting – types, addresses, forwarding. Overview of ICMP & IGMP. Mobile IP – Addressing, Agents & Phases.

Transport Layer – Services, Protocols – Stop-and-wait, Go-Back-N, Selective Repeat, Piggybacking. Datagrams & UDP – Services & Applications. TCP – Services, Features, States. Windows in TCP, Flow & Error Control, Congestion Control, Timers.

Session and Application Layer – Introduction to WWW and HTTP, FTP, SMTP, TELNET, SSH, DNS and SNMP. Introduction to Multimedia and Compression. RTP & RTCP, SIP.

Introduction to Wireless Networks - Basics of Radio Transmission – Signals, Antennas, Signal Propagation. Wireless LAN - Infrared Vs Radio transmissions, Infrastructure and Adhoc networks, IEEE 802.11 b/a/g, Bluetooth. Adhoc Networks - Routing algorithms & Metrics. Introduction to Cellular Network Architecture - Protocols, Localization and Calling, Handover. Overview of GSM, 3G and 4G Networks. Overview of Cryptography & Network Security.

SIXTH SEMESTER

CSE 321A VISUAL COMPUTING (CSE)

3L **3 Hours, 80 Marks**

Visual Synthesis. Taxonomy of Computer Graphics – Raster & Vector Displays, Frame Buffer, Persistence, Resolution, Refresh Rate, Aspect Ratio. Interactive vs Passive Graphics Systems. Input Modes & Methods. Basics of Coordinate Systems – Points, Lines, Planes and Curves. Color Generation – RGB, CMYK, HSV.

Two-Dimensional Systems – 2D Objects Representation, 2-D Transformations, 2-D Viewing Pipeline, Clipping. Polygon Filling. Antialiasing. Three-Dimensional Systems – Projection Methods, Degrees of Freedom, 3-D Graphics Pipeline, 3-D Object Representation – Polygon Surfaces, Polygon Meshes. Visible Surface Detection - Back face, Z-buffer, painter algorithm.

Concepts of Imaging Systems. The Pinhole Camera and its properties. Illumination Models – Ambient, Diffuse, Specular. Halftones and Dithering. Anatomy of a Digital Camera.

Image Based Visual Computing. Processing in Spatial and Frequency Domain. Image Filters - Convolution and Linear Filters. Blur, Sharpen and Edge Operations. Histogram, Color and Pixel level operations. Thresholding and Band Pass Filters. Non-Linear and Morphological Operations – Noise Filtering, Dilation, Erosion, Majority. Contour Properties & applications.

Definitions and Brief Introduction only – Image Segmentation, Registration, Restoration and Compression. Image Retrieval using Color, Shape and Texture. Object Detection & Recognition. Open Problems in Computer Vision.

CSE 322A – MODERN APPLICATION DEVELOPMENT (CSE/IT)

3L,1T **3 Hours, 80 Marks**

Components of Web Applications – Business Logic, Application Layer and Presentation Layer.

HTML5 Features – WebStorage (Local and Session Storage), App Cache, Web Workers, Server-Sent Events, Geolocation, Web Sockets, WebSQL Databases. Responsive Page Design – CSS Media Queries, Flexbox API.

Web Page Optimization. Page Speed Metrics, HTTP Caching – Cache-Control and ETags, HTTP Compression – Apache mod_deflate, Minification, CSS Sprites, Redirects, JS Optimizations.

API First Development – Concepts, Pros & Cons. RESTful APIs using JSON and XML. Progressive Web Apps – Service Workers, Cache API, Firebase Integration, Push Notifications.

Advanced PHP – Object-Oriented PHP Libraries, Typehints, Autoloaders, Composers, Front Controllers, PDO. Introduction to MVC and Templating Engines – Smarty.

Introduction to Containers, Hypervisors, CI/CD Pipelines. Introduction to Microservices and Serverless Architectures.

CSE 323A – JAVA PROGRAMMING (CSE/IT)

3L **3 Hours, 80 Marks**

Evolution of programming languages, generation of programming languages, type of programming languages.

Basic feature of Java, flow control, classes, objects, interfaces, exception and packages.
Java classes and object, access control and inheritance, constructions, inheritance and overloading. Extension of classes.

Data type, control-flow, basics of exception handling, operations on data types.
Introductory idea of threads and their applications.

Basic I0 packages and standard utilities. Application of Java for system programming.
Introduction to LINUX shell, variables, condition and control structures.

Introduction to TCL/TK programming language.

CSE 324A ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING(CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Overview of AI. The Turing AI test. AI Problems & Applications. Reasoning & Agents.
Basic Search: Strategies Problem spaces, Search strategies. Uniformed, Heuristics and informed search, Space and time efficiency of search. Two-player games. Basic Knowledge Representation and Reasoning – Propositional & Predicate Logic. Review of basic Probability Concepts – Random Variables, Probability Distributions, Axioms of Probability, Bayes' Rule, Correlation and Simpson's Paradox.

Machine Learning - Definition and learning tasks, Supervised, unsupervised and semi-supervised learning. Classification & Regression, Inductive learning. Training & Test datasets, Distance Metrics & Similarity Measures, Correlation & Higher Order Measures. Error Estimation. Classification Errors, Confusion Matrices.

Data - Bias and Variance, Pre-processing, Scaling and Dimensionality Reduction (PCA). Statistical learning - Naïve Bayes. Linear & Logistic Regression. Overfitting & Underfitting. Introduction to Decision Trees. Kernel Methods and Support Vector Machines. Ensemble Methods & Random Forests.
Perceptron & Neural Network Learning - Feed forward & Back Propagation Neural Networks. Gradient Descent, Activation Functions & Regularization. Unsupervised Learning and Challenges: Clustering, K-means, EM algorithms, Mixture of Gaussians. Overview of Deep Learning.

CSE 325A- PRINCIPLES OF COMPILER DESIGN (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Introduction of Translators, Compilers, Interpreters. Phases of Compiler, One Pass & Multipass Compilers, Bootstrapping. Lexical Analyzer, Input Buffering, Specification and Recognition of Tokens, Regular

Expressions to NDFA, Minimization of DFA, Keywords and Reserve word policies, Lex - The Lexical Analyzer Generator.

Syntax Analyzer, Review of Context Free Grammars, Ambiguity of Grammars, Left Recursion, Left Factoring. Top Down Parsing, Brute Force Parser, Recursive Descent Parser, Operator Precedence Parser, LL (1) Parser. Bottom Up Parsing, LR Parser, Construction of SLR, Canonical LR & LALR Parsing Tables, Yacc – The Parser Generator.

Syntax Directed Translation Schemes, Implementation of Syntax Directed Translators, Synthesized Attributes, Inherited Attributes, Construction of Syntax Trees, Bottom Up Evaluation of S- Attributed Definitions, L-Attributed Definitions, Top Down Translation of L-Attributed Definitions. Errors, Lexical Phase Errors, Syntactic Phase Errors. Intermediate Languages, Postfix Notation, Three Address Code- Triples, Quadruples and Indirect Triples. Translation of Assignment Statements, Boolean Expression and Control Structures.

Symbol Tables, Operation on Symbol Tables, Symbol Table Organization, Run Time Storage Management, Storage Allocation and Referencing Data in Block Structured Languages, Storage Allocation in Fortran.

Code Optimization, , Definition of Basic Block Control Flow Graphs, Dag Representation of Basic Block, Advantages of Dag, Sources of Optimization, Loop Optimization, Idea about Global Data Flow Analysis, Loop Invariant Computation, Peephole Optimization. Code Generation, A Machine Model, Register Allocation And Assignment, A Simple Code Generator, Code Generation from Dag's.

SEVENTH SEMESTER

CSE 411A: CRYPTOGRAPHY AND SECURITY (CSE/IT)

3L, 1T **3 HOURS, 80 MARKS**

Introduction to cryptography, Classical Cryptosystem, Block Cipher. Data Encryption Standard (DES), Triple DES, Modes of Operation, Stream Cipher. LFSR based Stream Cipher, Mathematical background, Abstract algebra, Number Theory. Modular Inverse, Extended Euclid Algorithm, Fermat's Little Theorem, Euler Phi-Function, Euler's theorem.

Advanced Encryption Standard (AES), Introduction to Public Key Cryptosystem, Diffie-Hellman Key Exchange, Knapsack Cryptosystem, RSA Cryptosystem. Primarily Testing, ElGamal Cryptosystem, Elliptic Curve over the Reals, Elliptic curve Modulo a Prime. Generalized ElGamal Public Key Cryptosystem, Rabin Cryptosystem.

Message Authentication, Digital Signature, Key Management, Key Exchange, Hash Function. Cryptographic Hash Function, Secure Hash Algorithm (SHA), Digital Signature Standard (DSS).

Cryptanalysis, Time-Memory Trade-off Attack, Differential and Linear Cryptanalysis. Cryptanalysis on Stream Cipher, Modern Stream Ciphers, Shamir's secret sharing and BE, Identity-based Encryption (IBE), Attribute-based Encryption (ABE).

Side-channel attack, The Secure Sockets Layer (SSL), Pretty Good Privacy (PGP), Introduction to Quantum Cryptography, Blockchain, Bitcoin and Cryptocurrency.

CSE 412A: DATA SCIENCE AND ANALYTICS (CSE)

3L, 1T **3 HOURS, 80 MARKS**

Concept and History of Data Science. Overview and Traits of Big data, Objectives & Applications of Analytics. Data Driven Business Models and Challenges. Introduction to Data Pipelines and Data Governance. Analysis vs Reporting. Types of Variables -Numerical, Categorical (Nominal & Ordinal).

Descriptive Analytics – Single and Multi-variate analysis. Graphical Representation – Bar, Pie, Box Plots, Histograms, Scatter Plots, Contour Plots. Measures of Central Tendency, Measures of Dispersion, Higher Order Moments. Correlation and Variance Analysis, Simpson’s Paradox. Inferential Analytics - Independence and Conditional Probability, Entropy. Estimation and Confidence Intervals. Single Sample and Two Sample Tests. Hypothesis and Inference, Null Hypothesis. Chi-square Test.

Predictive Analytics – Linear Regression - Model Assumptions, Regularization (lasso, ridge, elastic net) Classification algorithms - K-Nearest Neighbors, Logistic Regression, Decision trees, Support Vector Machines (SVM), Neural Networks. Clustering: K-means, Associative Rule Mining.

Time Series Analysis - Linear Systems Analysis, Nonlinear Dynamics, Rule Induction. Data Collection – Design of Experiments (DOE), Active (Offline) and Reinforcement (Online) Learning. Web Scrapping and Public APIs (e.g. Twitter APIs).

Case Study of Data Science Applications. Example - Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis. Introduction to Open-Source Data Science Toolkit – R, Python, Weka. Libraries - Matplotlib, NumPy, Pandas, Scikit-learn, Tensorflow. Anaconda & Jupyter distributions.

CSE 413A- SOFTWARE ENGINEERING (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Taxonomy of Software Development Life Cycle. Models – Waterfall, Spiral, Prototype, Agile, TSP, Extreme Programming. Introduction to Scrum terminology – Product backlog, Increments, ScrumMaster, Sprint, Velocity. Understanding Requirements. Functional and Non-Functional Requirements. Requirements Elicitation. User vs System Requirements. Requirement Specification & Validation. Change Management.

Aspects of Software Design – Attributes of a Good Design. Identifying Actors, Use cases and Activities. Functional Design – Top Down vs Bottom Up. Object-Oriented Design – Classes, Hierarchies, Aggregation & Relationships. Modelling structure, interactions and behavior. Unified Modelling Language. Component Level Design – Coupling and Cohesion. Data Flow and Process Specification, Design Principles – STUPID, SOLID, GRASP.

Software Architecture – Importance and Views. Architectural Styles – Client-Server, Component Based, Domain Driven, MVC, Layered, N-Tier, Object-Oriented, Service-Oriented, RESTful and Microservices Architecture. Architecture Description. Component and Deployment Diagrams. Software Project Planning, Software Metrics – LoC, FP, Complexity. Scheduling and Cost Estimation.

Implementation Challenges. Reuse - Design Patterns (Bridge, Adapter, Strategy, Factory, Command, Composite, Decorator, Proxy, Observer). Version Control – Git. Code Quality – Readability, Documentation and Plagiarism. Globalization – Character Sets, Timezones, Currencies, Laws and Taxation. Personalization – User Preferences, Demographic, Device Specific, Privacy.

Importance of Software Quality Assurance. Software Reviews, Test-Driven Development. Unit Testing. Black & White box testing. Functional Tests. Introduction to Test Automation with JUnit. Software Acceptance. Verification and Validation.

CSE 414 A – ROBOTICS & EMBEDDED SYSTEM (CSE)

3L, 1T **3 Hours, 80 Marks**

Introduction to Automation and Robotics, present and future applications, classification by coordinate system. Components of the Industrial Robotics: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom, requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

Motion Analysis: Homogeneous transformations as applicable to rotation and translation numerical problems. Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates. Forward and inverse kinematics numerical problems.
Trajectory planning and avoidance of obstacles, path planning, Robot actuators and feed back components: position sensors – potentiometers, resolvers, encoders and velocity sensors.

Introduction to Embedded systems, Applications of Embedded Systems, Software tools, Microcontroller Families, Introduction to AVR microcontrollers, Interfacing of:

LEDs, Switches, Relays, LCD, 7 Segment Display, ADC, Stepper Motors, DC Motors, IR Sensors, Serial Communication, GSM module, GPS module, I2C devices, PWM Techniques, Cross Compilers.

Mini software/hardware/simulation project.

EIGHTH SEMESTER

CSE 421 A – INTERNET OF THINGS (CSE)

3L, 1T **3 Hours, 80 Marks**

Introduction to IoT, Architectural Overview, Design principles and needed capabilities, IoT Applications. Sensing and Actuation. IoT sensors – motion (location, acceleration, direction and orientation), environmental (temperature, humidity, pressure), chemical (water quality and gas), physical (proximity, smoke, water level, reed switch) and perception (optical, infrared, auditory) sensors. IoT Actuators – Motors (Servo, Stepper, DC, Linear), Relays, Solenoids.

Basics of Networking. Devices and Gateways. Communication Protocols – BLE, WiFi, ZigBee, LoRa, NFC. Data Protocols – MQTT, AMQP, CoAP & XMPP. Wireless Sensor Networks. Machine-to-Machine Communications (M2M). Interoperability in IoT.

Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino. Introduction to Raspberry Pi. Implementation of IoT systems using Raspberry Pi. Connecting RPi to internet. Running Python programs on RPi.

Server Components – Client-Server and RESTful architectures. Introduction to SDN, SDN for IoT. Cloud Architectures - Sensor-Cloud, Fog & Edge Computing. Energy Efficiency, QoS, QoE and Everything as a Service (XaaS). Unstructured vs Structured Data Storage. Searching and Data Analytics in IoT.

Authentication & Authorization, Business Processes in IoT, Security in IoT, Data Governance & Privacy. Big Data in IoT. Case Studies - Smart Cities and Smart Homes. Connected Vehicles, Smart Grid, Industrial IoT. Internet of Medical Things. Case Study: Agriculture, Healthcare, Activity Monitoring.

CSE 422 A – CLOUD COMPUTING (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Overview of Computing Paradigm : Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing, Evolution of cloud computing, Business driver for adopting cloud computing. History of Cloud Computing, Cloud service providers, Properties, Characteristics & Disadvantages, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing, Role of Open Standards.

Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, Role of Networks in Cloud computing, protocols used, Role of Web services, Service Models (XaaS), Deployment Models & types of cloud.

Infrastructure as a Service(IaaS) :Introduction to IaaS, Virtualization, Approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM), Resource Virtualization, Server, Storage, Network, Virtual Machine(resource) provisioning and manageability, Data storage in cloud computing, storage as a service. Platform as a Service(PaaS) :Introduction to PaaS, Service Oriented Architecture (SOA), Cloud Platform and Management, Computation, Storage, Examples, Google App Engine, Microsoft Azure, SalesForce platforms.

Software as a Service(PaaS) : Introduction to SaaS, Web services,Web 2.0,Web OS. Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional

vs. Cloud, Economics of scaling: Benefitting enormously, Managing Data, Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud,Large Scale Data Processing

Cloud Security: Infrastructure Security, Network level security, Host level security, Application level security, Data security and Storage, Data privacy and security Issues, Jurisdictional issues raised by Data location, Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations. Case Study on Open Source & Commercial Clouds: Examples - Open stack, Microsoft Azure, Amazon AWS, Google Cloud.

ELECTIVE-I

CSE 453A – CLIENT-SERVER TECHNOLOGY (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Introduction: Client/Server architecture, Benefits, application, centralize multiuser, Distributed single user architecture, distributed computing environment.

Approach to Distribution: Distributed models, multi tiered environment, cooperative processing, application components, and distribution points. Presentation distribution, distributed processing, distributed function and transaction processing, data distribution.

Client technologies: Function, Application and tools, operating system, hardware plate forms, database access, interprocess communication tools.

Server technologies: Function, server operating system, hardware plate forms, data access, distributed data access, database engines.

System networks Architectures: Components, layers, pear-to-pear communication between SNA layers.

Data Management: Distributed data management, method of the distribution, distributed data access. Database transaction management.

Distributed DBMS: Architecture, storing data in a distributed DBMS, Distributed catalog, management, Distributed query processing, Update distributed data. Introduction to distributed transactions, distributed concurrency control, and distributed recovery.

CSE 454 A – MULTIMEDIA TECHNOLOGY (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Introduction to multimedia and its applications, Basic requirements for multimedia, Multimedia building blocks - Text, Sound, Images, Animation, Video and related tools.

Multimedia Hardware: SCSI, MCI, Memory and storage devices, Output Hardware, Communication devices.

Multimedia Software: Basic tools - Painting and drawing tools, 3-D modelling and animation tools, Images and editing tools, OCR software, Sound Editing programs, Animation, Video and Digital Movies, Video Formats, Compressing movie files.

Multimedia Authoring tools: Selecting a right tool based on various features, card and page based authoring tools, Icon based authoring tools, Time based authoring tools, Object - Oriented Tools.

Assembling and delivering a project: The multimedia team, Planning and costing, designing and producing.

Multimedia and the internet: working of internet, Tools for www - web page makers and editors, HTML and Multimedia, Video on demand, Images, sound and animation for the web.

ELECTIVE-II

CSE 462A–OBJECT ORIENTED SOFTWARE ENGINEERING (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Object-oriented concepts and principles. Identifying the elements of an object model. Object oriented projects metrics and estimation.

Object-oriented analysis: Domain analysis, the OOA process, the object-relationship model.

Design for object- oriented systems. The system design process.

Object-oriented testing - testing OOA and OOD models. The object-oriented testing strategies. Inter class testing.

Technical metrics for O-O systems. Class-oriented metrics & metrics for O-O projects.

Advanced topics in software engineering. Component-based software engineering and development. Classifying and retrieving components.
Review of CASE tools.

CSE 464A – REAL TIME SYSTEMS (CSE)

3L, 1T **3 Hours, 80 Marks**

Introduction to real-time computing: Characteristics of real-time system & tasks, performance measurement of real-time systems, estimation of program runtime.

Real-time system design: hardware requirements, systems development cycle, data-transfer techniques, synchronous and asynchronous data-transfer techniques, standard interfaces.

Task assignment and scheduling: priority scheduling, dynamic scheduling, buses in dynamic scheduling, dynamic priority assignment. Real-time programming languages and tools. Desired language characteristics, data typing. Control structure, run-time error handling, over-loading and generics, run-time support, real-time databases.

Real-time communication, fault-tolerance techniques, cause of failure, fault types, fault detection, redundancy, integrated failure handling.

Reliability evaluation techniques; parameter values, reliability model for hardware redundancy, software error model, clock synchronization.

CSE 466 A - GRAPH THEORY (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Introduction to graphs, applications, representation of graphs. Walk, Paths and circuits. Isomorphism, connectedness, Euler graph, subgraph, operations on graph, Hamiltonian Paths and Circuits, Traveling Salesman problem, algorithm of graph traversals, connectedness.

Tree, Spanning tree, Fundamental Circuits, Cut-sets, Connectivity and Separability,

1-isomorphism, 2-Isomorphism, Network flow, Algorithm for spanning tree, cut vertex.

Planar and Dual graphs, Kuratowski's two graph, representations of planar graph, algorithm for detection of planarity, geometric and combinatorial dual graph, thickness and crossings.

Matrix representation of graphs, incident matrix circuit matrix, cutset matrix, path matrix, adjacency matrix. Coloring, covering and partitioning, chromatic number, chromatic polynomial, matching, bipartite graph, four color problem.

Directed graphs, types, binary relations, connectedness, Euler digraph, tree, fundamental circuits, adjacency matrix, tournaments, acyclic digraph, decyclization, algorithm for finding directed circuits.

CSE 470A – COMPUTATIONAL SCIENCE (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Modeling and Simulation: Definition of simulation and modeling; relationship between simulation and modeling, Purpose including benefits and limitations: role – addressing performance, optimization; supporting decision, making, forecasting, safety considerations.

Application areas: healthcare (including assisting with diagnostics); economics and finance; city and urban simulations; simulation in science and in engineering.

Types of simulations – physical, human in the loop, interaction, computer, virtual reality. The simulation process. simplifying, assumptions; validation of outcomes.

Model building: use of mathematical formula or equation, graphs, constraints. Methodologies and techniques. Use of time stepping for dynamic systems.

Theoretical considerations; Monte Carlo methods, stochastic processes, queuing theory. Software in support of simulation and modeling; packages, languages.

Operations Research: Linear programming: Integer programming, The Simplex method, Probabilistic modeling, Queuing theory, Markov models and chains, Prediction and estimation, Decision analysis, Forecasting, Risk management.

Software tools for Simulations and Modeling.

ELECTIVE-III

CSE 465 A - INFORMATION THEORY AND CODING (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Uncertainty, information, measure of information, average information, entropy, property of entropy, information rate. Discrete memoryless source, Source coding theorem,

Discrete memoryless channel, self and Mutual information, properties, channel capacity, channel coding theorem, Shannon – Hartley theorem, Information capacity theorem.

Data compaction, prefix coding, Huffman coding, Lempal-Ziv coding. Compression of information.

Type of errors, codes, error control coding, linear block code, error detection and correction codes, syndrome decoding, cyclic codes, hamming code, BCH, convolution codes, encoders and decoders, performance of codes.

CSE 469A-BIOINFORMATICS (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Introduction to Molecular Biology and Biological chemistry: Genetic material, Gene structure and information content, protein structure and functions, nature of chemical bonds, molecular biology tools, genomic information content.

Data Searches and pair-wise alignments: Dot plots, Gaps, Dynamic Programming, database searches and family of algorithms –BLAST and FASTA.

Substitution patterns: Pattern substitution with in genes, estimating substitution numbers, variation of evolutionary rates between genes, molecular clocks.

Phylogenetics: Its history, phylogentic trees, distance matrix methods. Character-based methods – parsimony, ancestral sequences. Strategies for faster searches – branch and bound, heuristic. Consensus trees, parametric tests. The tree of life.

Genomics and gene Recognition: prokaryotic and eukaryotic genomes and their structures, open reading frames, gene expression.

Protein and RNA structure prediction: Amino-acids, polypeptide composition, structure. Algorithms for modeling protein folding, and reverse protein folding.

Information integration for life science discovery: Nature of biological data, data sources, challenges in information integration.

CSE 471A – BLOCKCHAIN (CSE/IT)

3L, 1T **3 Hours, 80 Marks**

Introduction, The consensus problem, Asynchronous Byzantine Agreement, AAP protocol and its analysis, Nakamoto Consensus on permission-less, nameless, peer-to-peer network, Abstract Models for Blockchain, GARAY model, RLA Model, Proof of Work (PoW) as random oracle, formal treatment of consistency, liveness and fairness, Proof of Stake (PoS) based Chains, Hybrid models (PoW + PoS).

Cryptographic basics for cryptocurrency, a short overview of Hashing, Signature schemes, encryption schemes, public key crypto, verifiable random functions, Zero-knowledge systems.

Bitcoin, Wallet, Blocks, Bitcoin Data Structures, Merkley Tree, LPV nodes, hardness of mining, transaction verifiability, anonymity, forks, double spending, Mathematical analysis of properties of Bitcoin.

Ethereum, Ethereum Virtual Machine (EVM), EVEM Data Structures, Alternative Data Structures, Wallets for Ethereum, Solidity, Solidity pitfalls and disasters, Smart Contracts, Some attacks on smart contracts, ICO token, Cryptokitties.

Trends and Topics - Permissioned Blockchains, Hyperledger Fabric, Concurrent Contract Execution, Zero Knowledge proofs and protocols in Blockchain, Zcash, Succinct non interactive argument for Knowledge (SNARK), pairing on Elliptic curves.

CSE 472 A - ADVANCED COMPUTER ARCHITECTURE (CSE)

3L, 1T **3 Hours, 80 Marks**

Introduction to parallel processing and trends: parallelism in uni-processor system, parallel computer structure, architectural classification schemes for parallel computers, multiplicity of instruction – data streams, serial versus parallel computers, parallelism versus pipelining.

Memory hierarchy: hierarchical memory structures, virtual memory system, memory allocation and management.

Principles of pipelining: pipelining principles and classifications, general pipelines and reservation tables, interleaved memory organization, instruction pre-fetch and branch handling, data buffering and busing structures, internal forwarding and register tagging, hazard detection and resolution, job sequencing and collision prevention, dynamic pipelines and reconfigurability.

Structure for array processors: SIMD computer organization, masking and data routing mechanism Inter PE communication, introduction to associative array processing.

Multiprocessor architecture: loosely coupled and tightly coupled multiprocessors, processor characteristics for multiprocessing, interconnection networks, cache coherence protocols.

Introduction to advance processors: Data flow computers, the VLIW architecture, fault tolerant architecture and study of TANDEM HIMALAYAN K2 system architecture.

SYLLABUS OF OPEN ELECTIVES-I

BCT 291 A Open Elective-I: Sustainable Architecture

3L **3 Hrs, MM 100**

Concepts of sustainability : Energy and Global environment, Energy use and Climate change – Its impact, Types of Energy systems, Concept of Sustainability - Principles of conservation -synergy with nature, Bioregionalism - community basis shelter technology within bioregional patterns and scales, Ethical- environmental degradation.

Sustainable planning & Design: Sustainable Development -Sustainable approach to site planning and design - site inventories- relationships between site factors - development impacts from one area of the site on the other areas - phasing of development - limits of change - Design facility within social and environmental thresholds

Sustainable Building Materials and Construction : Properties, Uses and Examples of -Primary, secondary and Tertiary Sustainable Materials, Principles to improve the energy efficiency - siting and vernacular design, shade, ventilation, earth shelter, thermal inertia and air lock entrances. Techniques of sustainable construction - technologies, methods of effectiveness, and design synthesis – alternative materials and construction methods: solar water heating panels; photovoltaic electricity generation; use of local materials and on site growth of food, fuel and building materials.

Recycling and Reuse : Pre building, Building, Post building stages - Architectural Reuse, Waste prevention, Construction and Demolition recycling- Conservation of natural and building resources- Energy and material savings – types of wastes - Elimination of waste and minimize pollution- various Decomposing methods – Innovative reuse of various wastes Case Studies and Rating systems : Sustainable Development Case Studies: illustrated examples of the planning, development, and construction. Green architecture and various international rating systems for sustainability- EAM (UK), CASBEE (Japan), LEED (US), Green Star (Australia), etc. – Indian systems – TERI GRIHA rating, LEED India rating, IGBC

CE 291A Open Elective-I :Energy Efficient Building Design

3L **3 Hrs, MM:100**

Environment and man, external environment and built environment, Built-environment – integrated approach.
Climate: elements of climate, classification of climate, Micro-climate, site climate.
Comfort: desirable conditions, thermal comfort factors, comfort indices, effective and corrected effective temp. Tropical summer index.
Thermal Design: heat loss from a building under steady state condition, heat gains due to solar radiation, steady state and cyclic conditions, Means of thermal control – mechanical, structural control, air infiltration into buildings by natural means, shape of buildings,-thermal cube, fabric heat loss, ventilation loss and volume.
Light & Lighting: illumination requirement, day-lighting, artificial lighting, energy conservation.
Noise Control: Sources of noise, means of control, control requirements, behaviour of sound in rooms, vibration & vibration control.
Building Services: Mechanical & electrical services in building, lifts, escalators.

ChE 291 A Open Elective-I : Renewable Energy Sources

3L **3 Hrs, MM:100**

Sources of energy: Energy sources and their availability, renewable energy sources.
Energy from Biomass: Introduction, Biomass as a source of energy, Biomass conversion technologies, Biogas generation, classification of biogas plants, Biomass gasification.
Solar Energy: Sun and solar energy, solar radiation and its measurement, solar energy collectors, solar energy storage, Photovoltaic systems, Application of solar energy.
Wind Energy: Wind as an Energy source, Basic principles of wind energy conversion, Types of Wind machines, Components of wind energy conversion system, Performance of wind machines, application of wind energy.
Geothermal Energy: Introduction, Origin and distribution of geothermal energy, types of geothermal resources, Hybrid geothermal power plant, Application of geothermal energy.
Hydrogen energy: Introduction, Hydrogen production, Hydrogen storage, Hydrogen transportation.
Energy from the Oceans: Introduction, Ocean Thermal Electric Conversion (OTEC), Energy from Tides, Ocean Waves.

EE 291 A Open Elective I: Industrial Application Of Electrical Drives

3L **3 Hours, 100 Marks**

Operating-Characteristics : Individual, group and collective drives, steady state individual and joint characteristics of electric motors and driven industrial units under different conditions of operation.

Transient Characteristics : Causes of transient conditions starting, braking, reversing, speed transition and sudden system changes. Forces and torques on the drives referred to a common reference shaft. General equation of motion, Accelerating and deaccelerating times. Starting and braking time and means of reducing.

Drives Control : Parameters characterizing speed control methods of electric drives, speed control of Industrial d.c. and a.c. motors under constant and varying torque and h.p. conditions.

Families of speed torque characteristics : Idea of manual and automatic control gears, Master-controller.

Motor Ratings : Continuous-short time and intermittent ratings, overload capacity. Effect of altitude, Motor heating and cooling curves. Equivalent current, power and torque. Selection motor for various duty cycles. Permissible frequency of starting, features of load diagram construction. Load equalisation and use of fly wheels. Types of motor enclosures.

Illumination : Units of light, Point , linear and surfact sources. Laws of illumination. Candle power distribution, MSCP and reduction factor, Indoor lighting system and their classification. Contrast, glare, shadow and colour. Mounting height and spacing. General and local lighting Total lumen and point by point methods of calculations. Outdoor lighting distributor and protector fittings. Isolux diagram. Flood, gas, discharge and arc-lamp-working, characteristics and applications.

Electric Heating and Welding : Principles of electric heating. Direct and indirect resistance heating, lead baths and salf baths. Resistance oven convection and rediation ovens. Arc resistance and induction furnance, elements of operation, performance and power supply arrangements. temperature regulation of ovens and furnances. Induction, high frequency and dielectric heating and their uses. Elementary study of different kinds of electric welding operation, Power supply for welding. Elements of Electrics Traction : Electric traction versus others System of electric traction for tramways, trolley buses, motor coach trains and locomotive hauled trains. Idea about suitability of electric motor for traction. Conductor rail and pantograph. meaning for multiple-unit operation.

Economics : Methods for economic selection of Industrial drives, loss factor and cost of losses, Effect of load factor. Power factor and factory diversity factor. Methods of power factor improvement and its economic limit. Economic calculations for illumination schemes Echnomic value of good lighting.

EE 292 A Open Elective I: Engineering Economics

3L **3 Hours, 100 Marks**

Introduction: Economics for Electrical Engineering, concept of physical efficiency and financial efficiency of electrical goods and services supply and demand, Elasticity. Necessities and luxuries, free competition, monopoly, law of diminishing returns.

Interest and Depreciation: Interest rates and equivalence, annuities and various factors, concept of depreciation in utilizing electrical energy, economic life of electrical machines, salvage value, various methods of depreciation calculations, equivalent capital recovery depreciation.

Economical choice of Electrical Apparatus: Motors, transformers, Economical choice between synchronous motors and Induction motor running them simultaneously.

Comparison of Alternatives: Basic economic study patterns, annual cost, capitalized cost, present worth, rate of return, Increment investment, pay back and benefit to cost ratio methods and their respective fields of applications.

Ma-291 A Open Elective-I :Mathematical Statistics for Engineers

3L **3 Hrs., M M :100**

Theory of probability : Theoretical probability distribution (Binomial, Poisson and Normal).
Correlation and Regression Analysis : Karl-Pearson's coefficient , Spearman's coefficient, Regression analysis of two variables system.
Sampling Theory : Test of significance, Large sample tests for mean and proportions. χ^2 (chi-square) , t and F Test of significance for Small sample.
Theory of attributes: association and independence of attributes, coefficient of association.
Index Number: Various types of index numbers, construction of index number of prices, fixed base and chain base methods

ME- 291A Open Elective-I: Renewable Energy Sources

3L **3 Hrs, MM:100**

Principal types of fossil fuel fired power plants and their effects on livestock and environment; Concepts of NCES, Criteria for assessing the potential of NCES, Limitations of RES.

Solar Energy - Solar radiation data, solar energy conversion into heat, Analysis of Flat plate and Concentrating collectors, Testing procedures, Paraboloid Dish, Central Receiver; concept of collector tracking, energy storage systems; Solar thermal systems for residential water heating, Solar Pond, industrial process heating and power generation. Photo voltaic: p-n junctions, I-V characteristics of solar cells, Calculation of energy for photovoltaic power generation; Battery Characteristics, DC Power Conditioning Converters, AC Power Conditioning -Inverters.

***Wind Energy*:** Energy available from wind, General formula, Lift and drag. Basis of Wind energy conversion, Effect of density, Frequency variances, Angle of attack, Wind speed, Determination of torque coefficient, Principle of Operation of wind turbines, types of wind turbines and characteristics, Generators for Wind Turbines, Control strategies.

Biomass and Biofuels: Conversion routes- combustion, pyrolysis of biomass to produce solid, liquid and gaseous fuels; Constructional details of gasifier; Aerobic and anaerobic digestion, Biofuels and their production; biofuels, Biomass systems for thermal applications and power generation.

Geothermal Energy: Definition and classification of resources, typical geothermal gradient; Dry, flash and binary steam systems; Utilization for electricity generation and direct heating, Wellhead power generating units. Basic features: Atmospheric exhaust and condensing, Exhaust types of conventional steam turbines.

An overview of other renewable devices- Fuel cells: principle, types, applications; Ocean thermal energy conversion (OTEC), Thermoelectric, MHD, Wave energy, Tidal energy, etc.

Economic Viability: Calculation of the cost of energy supply from renewables, Payback period, Carbon footprints; Comparison with conventional fossil fuel driven systems in terms of costs and emissions; Calculation of carbon dioxide reduction and incremental costs for renewable options.

ME 292 A Open Elective-I: Automobile Engineering

3L **3Hrs, MM:100**

Power Unit: Automobile engine types, classification; Engine parts: cylinder head, block and crank case, piston and rings; Carburation, fuel injection, valve operation; Fuel combustion, mechanical power and engine performance characteristics; Engine cooling and thermal stresses in parts,.

Chassis and Suspension: Load on frame, general considerations for strength and stiffness, engine mounting; Dampers, leaf and coil springs, various arrangements of suspension systems.

Transmission System: Clutches, flywheels, torque convertors; Gear-box: simple, synchromesh and overdrive; Type of universal joints, propeller shaft, differential; Rolling, air, gradient resistances and propulsive power calculation.

Steering: Steering geometry, Ackermann and Davis steering mechanisms; Telescopic steering; Steering shaft, gear-box, linkages, steering angles, front and rear axles; Vehicle longitudinal, static and dynamic balancing and electronic stability; Power steering: types and mechanism; Effect of caster, camber, toe-in and toe-out on tyre wear.

Brakes and Tyres: Servo-action, brake components; Bendix and Gerling system lock-head, hydraulic, vacuum, air and power brakes, and retarders; Pneumatic and tubeless tyres;

Features of a Modern passanger Car: Introduction to ABS, Front and side air bags, EBD, Climatizer, ESP, night-vision dashboard system; sun-roofing, collision warning system, Hybrid cars.

MI 291A Open Elective-I: Tunneling for Engineering Projects (MI)

3L **3 Hrs, MM:100**

Tunneling: Introduction about tunnels, functions, advantages and disadvantages of tunnels compared to open cuts, Criteria for selection of size and shape of tunnels, consideration in tunneling, geological investigation, tunnel alignment, tunnel shafts, pilot tunnels. Advantages of twin tunnels and pilot tunnels, portals and adits.

Conventional Method of Tunneling: Drilling, Blasting, Loading and Transport of Muck, Supports, Ventilation, Drainage, and Equipments. Drivage work in varying ground conditions using conventional methods

Fast Tunneling: Dill jumbos, trackless mucking and transportation units. Tunnel boring machine

Tunneling in Soft Ground: General characteristics of soft ground, shield methods, needle beam method and NATM method of tunneling in practice.

Tunneling (rock bolting and guniting), Safety measures, Ventilation in tunneling, Lighting, Drainage.

PI 291A Open Elective-I: Manufacturing Science

3L **3 Hrs, MM:100**

History and introduction to science of basic manufacturing processes and its classification.

Primary manufacturing processes: Introduction to liquid state forming process (casting), solid state forming process (drawing, extrusion, rolling, forging and other sheet metal working) and power state forming process (powder metallurgy).

Secondary manufacturing processes: Introduction to material removal processes

Conventional Machining processes (basic machining operations performed of lathe, shaper, milling, drilling and grinding machine).

Introduction to basic metal joining processes (welding, brazing, soldering and mechanical fastening).

Non conventional machining processes (Basic introduction, classification, need for their development, characteristics and their industrial applications).

SYLLABUS OF OPEN ELECTIVES-II

BCT 341 A Open Elective-II: Traditional Indian Architecture

3L, 3 Hrs, MM 100

To provide theoretical knowledge base on the uniqueness of Indian traditional Architecture principles, the meaning of space, the manifestation of energy, the selection of site and how 62 integration of built form with site happens at metaphysical level based on articulation of celestial grid.

To introduce the principles of Vastu and relationship between building and site. To familiarize the students with the units of measurement in traditional architecture. To introduce concepts of orientation and cosmogram according to the Vasthu Purusha Mandala. To study the detailing and design of various building components and their material and method of construction.

Vastu - its definition and classification - Relationship to earth.. Features of good building site - good building shapes - macro, micro, enclosed and material spaces - relationship between built space, living organism and universe - impact of built space on human psyche.

Orientation of building, site, layout and settlement - positive and negative energies - importance of cardinal and ordinal directions - The celestial grid or mandala and its types. The Vaastu Pursha Mandala and its significance in creation of patterns, and lay-outs, Types of lay-outs. Simple design of residential buildings.

Building heights -Base and basement - wall and roof specifications - column and beam designs - Pitched roof and domical roofs - significance of pyramid.

Use of wood, stone, metal, brick and time - marking technology, corbelling technology, jointing technology - foundations for heavy and light structures - Landscaping in and around buildings - Aesthetics in Indian Architecture.

CE 341A Open Elective-II: Non Urban Public Hygiene & Drinking Water

3L, 3 Hrs, MM 100

Communicable disease: Disease and immunity, communicable disease sources, mode of transfer. Control of communicable disease.

Fly and mosquito control: Life cycle of flies and mosquitoes. Various methods of fly and mosquitoes control.

Milk and food sanitation: Essential of dairy farm and cattle shed sanitation. Tests for milk and dairy products. Food epidemic, food poisoning. Botulism. Rural sanitation, village latrines, aqua privies, storm water and sullage problems, animal waste, methods of composting. Biogas collection and disposal of refuse, solid waste management through vermicomposting.

Septic tank (only salient features), percolation pits, sub surface disposal.

Rural water supply: Importance of village community in India, conditions of Indian villages with special regards to economic, social and health aspects. Quality of water needed for village community, sources of water for village water supplied, domestic roof water harvesting. Types of wells of sanitary aspects in well construction. Disinfections of wells. Different types of pumps used for village wells. Operation and maintenance of pumps, water borne diseases. Quality of water, human and cattle population and their water requirement. Rate of water supply. Standards of potable water. Rain water storage.

Treatment of water: Disinfection, desalination, Defluoridation, distribution of water.

ChE 341 A Open Elective-II: Petroleum Refining Technology

3L, 3 Hrs, MM 100

Origin occurrence of petroleum, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Petroleum refining processes, general processing, topping and vacuum distillations. Thermal cracking in vapor, liquid and mixed phase. Overview of Refinery Products

Catalytic cracking - Houdry fixed bed, fluidized bed, T.C.C. Houder flow etc. Catalytic reforming - conversion of petroleum gases into motor fuel with special reference to alkylation, polymerization, hydrogenation and dehydrogenation.

Treatment Techniques: Removal of Sulphur Compounds in all Petroleum Fractions to improve performance, Destruction of Sulphur Compounds and Catalytic Desulphurization, Solvent Treatment Processes, Dewaxing, Clay Treatment and Hydrofining.

Production of aviation gasoline, motor fuel, kerosene, diesel oil, tractor fuel and jet fuel, hydrodesulfurisation, Lubricating oil manufacture, Petroleum waxes and asphalts.

Octane number, Cetane number, Diesel index, their determination and importance Storage of petroleum products: tanks, bullets, special types of spheres etc. Transportation of petroleum products: road, rail, sea and pipeline; Importance of pipeline transportation.

EE 341 A Open Elective II: Optimization Techniques

3L 3 Hrs, 100 Marks

Introduction to Optimization : Historical Development, Engineering application of optimization, Statement & Classification of optimization problems, Classical optimization techniques for single & multiple variable functions.
Linear Programming : Introduction, application, standard form, Basic Solutions, Simplex method, Revised Simplex method, Duality, Transportation problem, Carmarkar's method.
Nonlinear programming : Unconstrained Optimization, Introduction, Fibonacci method, Golden section search, Gradient method, Newton's method, Quasi Newton method.
Dynamic Programming : Introduction, Multistage decision process, Concept of optimization & principle of optimality, Computational procedure in dynamic programming.
Advanced topics in optimization : Introduction, Separable programming, Multi objective optimization, Calculus of variation.
Books :
Engineering Optimization – S. S. Rao, New Age International Publishers.
An introduction to optimization – Er. K. P. Chong, S. H. Zak (Wiley Slident Edition)
Operations Research : An international – H. A. Taha (PHI)
Introduction to operation research – Hiller F.K. & Lieberman (TMH)

Ma 341 A Open Elective-II :Mathematical Theory of Operations Research

3L **3 Hrs., MM : 100**

Linear programming problems-Simplex Method, two phase method, Duality of LPP.
Theory of games: Competitive strategies, minimax and maximin criteria, two person zero-sum games with and without saddle point, dominance .
Inventories: Single item deterministic inventory models with finite and infinite rates of replenishment, economic lot-size model with known demand
Replacement problems: Replacement of item that deteriorate, replacement of items that fail completely, group replacement policty, individual replacement policy
Queing theory-Ques with Poisson input and exponential service time, the queue length, waiting time and busy period in steady state case, model with service in phase, multiserver queueing models.

ME 341A Open Elective-II : Economics Analysis and Management of Operations

3L **3 Hrs., MM: 100**

Business Goals & Form of Business Organization, Introduction to Management- Elements of Management, Principle of Management.
Concept of Costing- Breakeven Analysis, Deprecation & Estimate.
Marketing- 5Ps of Marketing- Product, Price, Demand Forecasting, Promotion, Person and Place. Concept of Advertising and It's Objective.
Financial Analysis-Statement and Financial Ratio.
Introduction to Privatization Liberalization, Globalization Ratio & Their Impact on Economy.

ME 342A Open Elective-II: Systems Design and Analysis

3L **3 Hrs., MM: 100**

Introduction: Basic concept of Finite element method; Rayleigh-Ritz and weighted residual method of variational approximation, Numerical Solution of equilibrium problem by Gaussian elimination.
Finite Element Analysis of One-dimensional Problem; Basic Concepts, derivation of elements equations, connectivity of elements, imposition of boundary conditions, Solution of equations, Application in One dimensional problem of Solid mechanics and heat transfer.
Finite Element Analysis of Two Dimensional Problem: Single variable problems: finite element discertization, interpolation, function, numerical integration and modeling considerations for triangular, rectangular, Quadrilateral, Isoparametric and Plane frame elements, Evaluation of equation and their solutions, Application in Two Dimensional Problem of Solid mechanics, Heat Transfer and Eigen value problems.

MI 341A Open Elective-II: Application of GIS & Remote Sensing in Engineering

3L **3 Hrs, MM:100**

Remote Sensing: Introduction to Remote Sensing, Terminology in Remote Sensing, Types of Remote sensing, advantage and disadvantage of remote sensing data, Electromagnetic radiation atmospheric. Windows remote sensing platforms and sensors systems, path-row referencing system, remote sensing data product, procedure for obtaining satellite data. Hardware and software related to remote sensing.
Different types of platforms, sensors and their characteristics, Orbital parameters of a satellite, Multi concept in remote sensing.

Image Interpretation and analysis: Elements of visual image interpretation, Digital image pre-processing, radiometric correction, geometric correction, resolution of remote sensing data, image enhancement, contract enhancement, spatial filtering band rationing image classification supervised and unsupervised classification, remote sensing applications in forestry, geology, hydrogeology, Land use and land cover mapping.
Principles of interpretation of aerial and satellite images, equipments and aids required for interpretation, ground truth – collection and verification, advantage of multidate and multiband images. Digital image Processing concept.
Geographic Information System (GIS): Fundamental of GIS: Basis concept including definition and history of GIS, Essential Elements of GIS, Uses and users of GIS, General GIS Applications, Geodesy, Grids, Datum's and projection systems, GIS Data structure, Data Formats, GIS layers and Digitization overview of GPS and its application, Hardware and software related to GIS.
Raster and vector Based GIS: Raster based GIS, Definition of Raster Based GIS, Spatial Referencing Definition and Representation of Raster Data. Vector based GIS, Definition and concept of vector based GIS, Data structure, Data Capture and Basic operations of spatial analysis, advantages and disadvantage in raster and vector based GIS, Introduction to network in GIS, GIS Project Planning Management and Implementation.
Application of GIS :in Map revision, Land use, Agriculture, Forestry, Archaeology, Municipal, Geology, water resources, soil Erosion, Land suitability analysis, change detection, Use of GIS in Mining.

PI 341A Open Elective-II: Principles of Management & Economics

3L **3 Hrs, MM: 100**

Introduction: Definition of management; Historical developments. Evolution of management; various schools of management theories; management functions; principles of management.
Types of organization: Organization and organization structures; Line, staff, function and committee type structures of organizations; flow of responsibility and authority in organization. Types of business organizations: sole proprietorship, partnership, private and public limited, co-operative societies, public sectors, joint sectors- their formation and dissolution.
Personnel management: Objectives of personnel management; functions of personnel management; nature of personnel management.
Economic analysis: Money time relationship; Law of supply and demand, Demand curves, demand elasticity, equilibrium concept, economies of scale.
Financial management: Assets and liabilities; balance sheet; profit and loss accounts, ratio analysis.
Operations management: Introduction to operations management; history, function and scope of operations management, areas of operations management; general model of managing operations; Introduction to production planning and control.
Introduction to marketing management; Budget and budgetary control; Purchasing process; Motivation; Leadership; Moral, job satisfaction.

SE 341A Open Elective-II :Structural Dynamics

3L **3 Hrs, MM: 100**

Vibrations of single degree of freedom system, sources of vibration, Types of vibration, Degree of freedom, spring action and damping, equation of motion of single degree of freedom system, undamped system of single degree of freedom, combination of stiffnesses, damped system of single degree of freedom, dry friction, damping forced vibration of damped system, introduction to multi degree freedom system.

SYLLABUS OF OPEN ELECTIVES-III

BCT 391 A Open Elective-III: Climate Responsive Architecture

3L, **3 Hrs, MM 100**

Understanding Climate and its impact on architectural design, fundamentals of climatology and environmental studies.
Introduction – Elements of Climate, measurement and representation of climatic data. Classification of climate, major climatic zones of India.
Thermal Comfort: Effect of climatic elements on Thermal comfort; indices for Thermal comfort Thermal performance of building elements: Thermal and physical properties of building materials and their effect on indoor environments.
Natural ventilation: Functions, effects of openings and external features on internal air circulation. Design considerations for achieving natural ventilation.
Sun path diagram, use of solar charts, types of shading devices
Day light factor: components, design considerations for indoor spaces
Micro Climate: factors and effects

Construction techniques for improving thermal performance of walls and roofs. Passive cooling techniques: traditional and contemporary

Design considerations for buildings and settlements in tropical climates with special reference to hot-dry, warm-humid and composite climates; Mahoney Tables.

Exercises:

Design of shading devices.

Layout of Residence for hot - dry, warm-humid and composite climates.

CE 391A Open Elective-III: Ecosystem & Biodiversity

3L, **3 Hrs, MM 100**

Concept of an ecosystem, structure & function of ecosystem, Bio-Geo chemical cycles (Hydrological, carbon, oxygen, nitrogen, phosphorus & sulphur cycle), energy flow in ecosystem, food chain

Major ecosystems (Description only) : Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystem, Riverine and stream ecosystem, Marine ecosystem, Estuarine ecosystem.

Biodiversity : Definition and its importance. Biodiversity at global, national & local level. Hot spots of biodiversity, Threats to biodiversity & causes of biodiversity loss. Conservation of biodiversity.

Value of biodiversity: Consumptive use, productive use, social value, ethical value, aesthetic value& optional value.

Bio-geographical classification of India. India as mega- diversity nation

ChE 391 A Open Elective-III: Nanotechnology

3L, **3 Hrs, MM 100**

Introduction to Nanotechnology: Introduction to nanotechnology and materials, Nanomaterials, Introduction to nano sizes and properties comparison with the bulk materials, different shapes and sizes and morphology.

Fabrication of Nanomaterials: Wet Chemical Synthesis Methods, Colloidal Nanoparticles Production, Sol Gel Methods, Microwave and Atomization, Gas phase Production Methods : Chemical Vapour Depositions.

Kinetics at Nanoscale: Nucleation and growth of particles, Issues of Aggregation of Particles, Layers of surface Charges, Zeta Potential and pH.

Carbon Nanomaterials: Synthesis of carbon buckyballs, List of stable carbon allotropes extended fullerenes, metallofullerenes solid C60, bucky onions nanotubes.

Nanomaterials characterization: Instrumentation Fractionation principles of Particle size measurements, Particle size and its distribution, XRD, Zeta potential Microscopies SEM, TEM, Atomic Forced Microscopy, Scanning and Tunneling Microscopy

Applications in Chemical Engineering: Self-assembly and molecular manufacturing : Surfactant based system Colloidal system applications, ZnO,TiO_2, Silver Nanoparticles Functional materials Applications, Production Techniques of Nanotubes, Carbon arc, bulk synthesis, commercial processes of synthesis of nanomaterials, Nanoclay, Commercial case study of nano synthesis - applications in chemical engineering.

EC 391 A Open Elective-III: Electronic Instrumentation

3L **3 Hrs, MM:100**

Transducers: Construction, characteristics and circuits for common types of resistive, capacitive, inductive, magneto-structive; piezo-electric. Photo-electric and thermo-electric transducers for measurement of process physical variables. Various sensing elements and transducers for measurement of Force, Pressure, Humidity, Moisture, strain, Velocity, Acceleration and pH. Inductive and Capacitive proximity switches. Physical and electrical loading of and by the transducer Systems.

Signal Conditioning: Analog and digital signal conditioning for instrumentation. Objectives of DAS, components of analog DAS and digital Data acquisition system, digital data recording system, multi channel DAS, modern digital acquisition system.

Electronic Displays: Principle of LED numeric, matrix and alpha-numeric displays, flat panel CRT, LCD, electro-luminiscent and electrophoretic and touch screen displays.

EE 391 A Open Elective III: Soft Computing Techniques

3L **3 Hours, 100 Marks**

Soft Computing : Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing.

Artificial Intelligence : Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies. Knowledge representation issues, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.

Neural Network : Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference between ANN and human brain, characteristics and applications of ANN, single layer network, Perceptron training algorithm.

Fuzzy rule base system : fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.

EE 392 A Open Elective III: Energy Conservation

3L **3 Hours, 100 Marks**

Elements of Energy Conservation and Management : General energy problem, Sector wise Energy consumption, demand supply gap, Scope for energy conservation and its benefits, Energy conservation Principle Maximum energy efficiency, Maximum cost effectiveness. Mandatory provisions of EC act Features of EC act Standards and labeling, designated consumers, Energy Conservation Building Codes (ECBC). Energy management concept and objectives Initializing Planning, Leading, Controlling, Promoting, Monitoring and Reporting, energy management programmes.

Energy Conservation Approaches In Industries : energy saving opportunities in electric motors Benefits of Power factor improvement and its techniques Shunt capacitor, Synchronous Condenser etc., Effects of harmonics on Motors, and remedies leading to energy conservation Energy conservation by VSD Methods and techniques of energy conservation in ventilation and air conditioners compressors pumps, fans and blowers Area Sealing, Insulating the Heating / cooling fluid pipes, automatic door closing Air curtain, Thermostat / Control Energy conservation in electric furnaces, ovens and boilers lighting techniques Natural, CFL, LED lighting sources and fittings

Energy Conservation in Power Generation, Transmission and Distribution : Performance improvement of existing power plant: cogeneration, small hydro, DG Set. Demand side management Load response programmes Types of tariff and restructuring of electric tariff Technical measures to optimize T and D losses.

Ma 391 A Open Elective-III: Advanced Numerical Analysis

3L **3 Hrs., MM : 100**

Solution of Algebraic and Transcendental Equations: Newton-Raphson method for real multiple roots, for complex roots and for system of non-linear equations; Synthetic Division, Birge-Vieta Method.

Solution of simultaneous Linear Equations and Eigen Value Problems: Direct methods: Gauss-elimination, Gauss-Jordan, Iterative Methods: Jacobi iteration, Gauss-seidel iteration and Successive Relaxation method. Eigen value Problems: power method

Curve fitting and Function Approximation: Chebyshev approximations, Chebyshev Expansion, Chebyshev Polynomials. Economization of Power Series.

Numerical Solution of Partial Differential Equations: Finite difference Approximation to partial derivatives. Solution of Laplace and poisson equations, Solution of one and two dimensional heat and wave equation by the method of separation of variables.

ME 391A Open Elective-III: Design Planning and Control of Production System

3L **3 Hrs, MM:100**

Production Planning: Planning horizon, product exploring, Make and buy decisions, operations planning, demand forecasting, conversion of forecast into production goal.

Scheduling: Operation sequencing and balancing, Scheduling for mass production and job order production, MRP, ERP.

Inventory System: Cost factors relevant to operations and inventory control, EOQ with shortages and uniform production, quantity discount.

Project Planning and Control:Network control, control cost consideration and optimization, Resource allocation and levelling, Aggregate production planning, decision rules.

Supply Chain Management:: Strategic framework of Supply chain – meaning, scope and performance of supply chain, supply chain drivers and obstacles. Role of e-business in a supply chain.

ME 392A Open Elective-III: Finite Elements Method

3L **3 Hrs, MM:100**

System Fundamental Concept: System definition, systems approach, Classification- General Systems, Discrete Systems, Controlled systems.

Procedure for Engineering a system: Defining system objective, formulation of objective criteria, Development of system alternatives.

Systems Optimization: Formulation of system, Design problem and application of search methods, Linear programing and dynamic programing for optimum solutions.

System Schedule: Time models, resource allocation, Time cost trade-off, system cost economic flow graph.

MI 391A Open Elective-III: Project Environment Clearance

3L **3 Hrs, MM:100**

Brief introduction of Environment Protection Act 1986 and other relevant legal provisions applicable to get environment clearance in India.

Impact of major engineering projects on various components of the environment: Socio-Economy, Land, Water, Air, Noise and others.

Preparation of Environment management plan: Public hearing, collecting baseline data, Environment impact assessment and predication, Environment management plan, environment monitoring and management.

PI 391A Open Elective-III: Quality Management

3L **3 Hrs,MM: 100**

Introduction: History of Quality, Objectives , importance and need of quality, Contributions of Quality Gurus- Juran, Deming, Crosby, Feigenbaum, Ishikawa, Taguchi etc., Impact of Quality on business performance.

Process and Statistical Quality Control: Quality System; Quality control techniques; Process capability; Control Charts- Theory of control charts, control limits and specification limits, Control charts for variables-X R Charts, Control Charts for attributes p, np, c and u charts.

Acceptance Sampling : Fundamental concepts of acceptance sampling; OC Curves; Single , Double and multiple sampling;

Quality Management: Introduction to Quality management; quality control and quality assurance; Quality control tools; cost of quality and cost of poor quality.

ISO 9000: ISO 9000 series; terminologies; need for ISO 9000 certification; basic procedure and work instructions; steps in ISO 9000 registration; Internal and third party audit for registration; Clauses of ISO 9000-2000 .

SE 391A Open Elective-III :Finite Element Method

3L **3 Hrs,MM: 100**

Introduction to Finite Element Method, Basic Concept of Finite Element Method, Analysis of continuum:- Structural, thermal, Potential etc., Finite Element Analysis of an elastic continuum:- Displacement approach, Direct Formulation, Energy Integral, Co and C1 continuity, Convergence criteria.

Elements:- Types and Properties. Conforming and Non conforming.

Shape Functions:- Langrangian and Serendity family for one and two dimensional cases.

Pascal triangle, Super / Sub and Iso parametric elements.

Steps in Finite Element Analysis of an elastic continuum.