PONDICHERRY UNIVERSITY

Bachelor of Technology

Artificial Intelligence and Machine Learning

REGULATIONS, CURRICULUM AND SYLLABUS

(2022- 2023)

PONDICHERRYUNIVERSITY

BACHELOR OF TECHNOLOGY PROGRAMMES

(EIGHT SEMESTERS)

REGULATIONS

1. CONDITIONS FOR ADMISSION:

(a) Candidates for admission to the first semester of the 8 semester B.Tech. Degree programme should be required to have passed:

The Higher Secondary Examination of the (10+2) curriculum (Academic Stream) prescribed by the Government of Tamil Nadu or any other examination equivalent there to with minimum of 45% marks(a mere pass for OBC and SC/ST candidates) in aggregate of subjects – Mathematics, Physics and any one of the following optional subjects: Chemistry / Biotechnology/ Computer Science / Biology (Botany & Zoology) or an Examination of any University or Authority recognized by the Executive Council of the Pondicherry University as equivalent thereto.

(b) For Lateral entry in to third semester of the eight semesters B.Tech programme:

The minimum qualification for admission is a pass in three year diploma or four year sandwich diploma course in engineering / technology with a minimum of 60 % marks (50% marks for OBC and a mere pass for SC/ST candidates) in aggregate in the subjects covered from 3rd to final semester or a pass in any B.Sc. course with mathematics as one of the subjects of study with a minimum of 60 % marks (50% marks for OBC and a mere pass for SC/ST candidates) in aggregate in main and ancillary subjects excluding language subjects. The list of diploma programs approved for admission for each of the degree programs is given in **Annexure A**.

2. AGE LIMIT:

The candidate should not have completed 21 years of age as on 1st July of the academic year under consideration. For Lateral Entry admission to second year of degree programme, candidates should not have completed 24 years as on 1st July of the academic year under consideration. In the case of SC/ST candidates, the age limit is relaxable by 3 years for both the cases.

3. DURATION OF PROGRAMME:

The Bachelor of Technology degree programme shall extend over a period of 8 consecutive semesters spread over 4 academic years – two semesters constituting one academic year. The duration of each semester shall normally be 15 weeks excluding examinations.

4. ELIGIBILITY FOR THE AWARD OF DEGREE:

No candidate shall be eligible for the award of the degree of Bachelor of Technology, unless he/she has undergone the course for a period of 8 semesters (4 academic years) / 6 semesters (3 academic years for Lateral Entry candidates) in the faculty of Engineering and has passed the prescribed examinations in all the semesters.

5. BRANCHES OF STUDY:

Branch I - Civil Engineering
Branch II - Mechanical Engineering
Branch III - Electronics & Communication Engineering
Branch IV - Computer Science & Engineering
Branch V - Electrical& Electronics Engineering
Branch VI - Chemical Engineering
Branch VII - Electronics & Instrumentation Engineering
Branch VIII - Information Technology
Branch IX - Instrumentation & Control Engineering
Branch X - Biomedical Engineering
Branch XI - Robotics and Automation
Branch XII – Food Technology
Branch XIII- CSE (Internet of Things & Cyber security including Block chain Technology)
Branch XIV – Artificial Intelligence and Machine Learning

or any other branches of study as and when offered. The branch allocation shall be ordinarily done at the time of admission of the candidate to the first semester.

6. SUBJECTS OF STUDY:

The subjects of study shall include theory and practical courses as given in the curriculum and shall be in accordance with the prescribed syllabus. The subjects of study for the first two semesters shall be common for all branches of study.

7. EXAMINATIONS:

The theory and practical examinations shall comprise continuous assessment throughout the semester in all subjects as well as university examinations conducted by Pondicherry University at the end of the semester (November / December or April / May).

(a) Theory courses for which there is a written paper of 75 marks in the university examination**.**

The Internal Assessment marks of 25 has to be distributed as 10 marks each for two class tests and 5 marks for class attendance in the particular subject. The distribution of marks for attendance is as follows:

5 marks for 95% and above
4 marks for 90% and above but below 95%
3 marks for 85% and above but below 90%
2 marks for 80% and above but below 85%
1 mark for 75% and above but below 80%

A minimum of three tests are to be conducted for every theory subject and, of them two best are to be considered for computation of internal assessment marks.

(b) Practical courses for which there is a university practical examination of 50marks: Every practical subject carries an internal assessment mark of 50 distributed as follows:

(i) Regular laboratory exercises and record – 20 marks
(ii) Internal practical test - 15 marks
(iii) Internal viva-voce – 5 marks
(iv) Attendance – 10 marks.

The marks earmarked for attendance are to be awarded as follows:
10 marks for 95% and above
8 marks for 90% and above but below 95%
6 marks for 85% and above but below 90%
4 marks for 80% and above but below 85%
2 marks for 75% and above but below 80%

8. REQUIREMENT FOR APPEARING FOR UNIVERSITY EXAMINATION:

A candidate shall be permitted to appear for university examinations at the end of any semester only if:

(i) He / She secures not less than 75% overall attendance arrived at by taking into account the total number of periods in all subjects put together offered by the institution for the semester under consideration.

(Candidates who secure overall attendance greater than 60% and less than 75% have to pay a condonation fee as prescribed by the University along with a medical certificate obtained from a medical officer not below the rank of Assistant Director)

(ii) He / She earns a progress certificate from the Head of the institution for having satisfactorily completed the course of study in all the subjects pertaining to that semester.

(iii) His / Her conduct is found to be satisfactory as certified by the Head of the institution.

A candidate who has satisfied the requirement (i) to (iii) shall be deemed to have satisfied the course requirements for the semester.

9. PROCEDURE FOR COMPLETING THE COURSE:

A candidate can join the course of study of any semester only at the time of its normal commencement and only if he/she has satisfied the course requirements for the previous semester and further has registered for the university examinations of the previous semester in all the subjects as well as all arrear subjects if any.

However, the entire course should be completed within 14 consecutive semesters (12 consecutive semesters for students admitted under lateral entry).

10. PASSING MINIMUM:

(i) A candidate shall be declared to have passed the examination in a subject of study only if he/she secures not less than 50% of the total marks (Internal Assessment plus University examination marks) and not less than 40%of the marks in University examination.

(ii) A candidate who has been declared –Failed in a particular subject may reappear for that subject during the subsequent semesters and secure a pass. However, there is a provision for revaluation of failed or passed subjects provided he/she fulfills the following norms for revaluation.

(a) Applications for revaluation should be filed within 4 weeks from the date of declaration of results or 15 days from the date of receipt of marks card whichever is earlier.

(b) The candidate should have attended all the college examinations as well as university examinations.

(c) If a candidate has failed in more than two papers in the current university examination, his/her representation for revaluation will not be considered.

(d) The request for revaluation must be made in the format prescribed duly recommended by the Head of the Institution along with the revaluation fee prescribed by the University.

The internal assessment marks obtained by the candidate shall be considered only in the first attempt for theory subjects alone. For the subsequent attempts, University examination marks will be made up to the total marks. Further the University examination marks obtained in the latest attempt shall alone remain valid in total suppression of the University examination marks obtained by the candidate in earlier attempts.

11. AWARD OF LETTER GRADES:

The assessment of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain points, will be awarded as per the range of total marks (out of 100) obtained by the candidate, as detailed below:

Range of Total Marks	Letter Grade	Grade Points
90 to 100	S	10
80 to 89	A	9
70 to 79	B	8
60 to 69	C	7
55 to 59	D	6
50 to 54	E	5
0 to 49	F	0
Incomplete	FA	

Note: _F_ denotes failure in the course. _FA_ denotes absent / detained as per clause 8.

After results are declared, grade sheets will be issued to the students. The grade sheets will contain the following details:

(a) The college in which the candidate has studied.

(b) The list of courses enrolled during the semester and the grades scored.

(c) The Grade Point Average (GPA) for the semester and The Cumulative Grade Point Average (CGPA) of all enrolled subjects from first semester onwards.

(d) GPA is the ratio of sum of the products of the number of credits (C) of courses registered and the corresponding grades points (GP) scored in those courses, taken for all the courses and sum of the number of credits of all the courses

$$GPA = (\text{Sum of}(C \times GP)/\text{Sum of } C)$$

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. FA grades are to be excluded for calculating GPA and CGPA.

(e) The conversion of CGPA into percentage marks is as given below

$$\% \text{ Mark} = (CGPA - 0.5) \times 10$$

12. AWARD OF CLASS AND RANK:

(i) A candidate who satisfies the course requirements for all semesters and who passes all the examinations prescribed for all the eight semesters (six semesters for lateral entry candidates) within a maximum period of 7 years (6 years for lateral entry candidates) reckoned from the commencement of the first semester to which the candidate was admitted shall be declared to have qualified for the award of degree.

(ii) A candidate who qualifies for the award of the degree passing in all subjects pertaining to semesters 3 to 8 in his/her first appearance within 6 consecutive semesters (3 academic years) and in addition secures a CGPA of 8.50 and above for the semesters 3 to 8 shall be declared to have passed the examination in **FIRST CLASS** with DISTINCTION.

(iii) A candidate who qualifies for the award of the degree by passing in all subjects relating to semesters 3 to 8 within a maximum period of eight semesters after his/her commencement of study in the third semester and in addition secures CGPA not less than 6.5 shall declared to have passed the examination in **FIRST CLASS**.

(iv) All other candidates who qualify for the award of degree shall be declared to have passed the examination in **SECOND CLASS**.

(v) For the Award of University ranks and Gold Medal for each branch of study, the CGPA secured from 1^{st} to 8^{th} semester alone should be considered and it is mandatory that the candidate should have passed all the subjects from 1^{st} to 8^{th} semester in the first attempt. Rank certificates would be issued to the first ten candidates in each branch of study.

13. PROVISION FOR WITHDRAWAL:

A candidate may, for valid reasons, and on the recommendation of the Head of the Institution be granted permission by the University to withdraw from writing the entire semester examination as one Unit. The withdrawal application shall be valid only if it is made earlier than the commencement of the last theory examination pertaining to that semester. Withdrawal shall be permitted only once during the entire course. Other conditions being satisfactory, candidates who withdraw are also eligible to be awarded DISTINCTION whereas they are not eligible to be awarded a rank.

14. DISCONTINUATION OF COURSE:

If a candidate wishes to temporarily discontinue the course for valid reasons, he/she shall apply through the Head of the Institution in advance and obtain a written order from the University permitting discontinuance. A candidate after temporary discontinuance may rejoin the course only at the commencement of the semester at which he/she discontinued, provided he/she pays the prescribed fees to the University. The total period of completion of the course reckoned from the commencement of the first semester to which

the candidate was admitted shall not in any case exceed 7 years, including of the period of discontinuance.

15. REVISION OF REGULATIONS AND CURRICULUM:

The University may from time to time revise, amend or change the regulations of curriculum and syllabus as and when found necessary

ANNEXURE – A

(Diploma programs for admission for B.Tech. Lateral Entry)

B.Tech courses in which admission is sought	**Diploma courses eligible for admission**
Civil Engineering	Civil Engineering Civil and Rural Engineering Architectural Assistantship Architecture Agricultural Engineering
Mechanical Engineering	Mechanical Engineering Automobile Engineering Agricultural Engineering Mechanical and Rural Engineering Refrigeration and Air-conditioning Agricultural Engineering & Farm Equipment Technology Metallurgy Production Engineering Machine Design & Drafting Machine tool maintenance and Repairs Printing Technology / Engineering Textile Engineering / Technology Tool Engineering
Electrical and Electronics Engineering Electronics & Communication Engineering Electronic and Instrumentation Engineering Instrumentation and Control Engineering Bio Medical Engineering	Electrical Engineering Electrical and Electronics Engineering Electronics and Instrumentation Engineering Instrumentation Engineering / Technology Electronics and Communication Engg. Electronics Engineering Medical Electronics Instrumentation and Control Engineering Applied Electronics
Robotics and Automation Engineering	Electrical and Electronics Engineering Electronics and Communication Engineering. Electronics and Instrumentation Engineering Computer Science and Engineering Information Technology Instrumentation and Control Engineering Mechanical Engineering Automobile Engineering Refrigeration and Air-conditioning Production Engineering

Chemical Engineering	Chemical Engineering Chemical Technology Petrochemical Technology Petroleum Engineering Ceramic Technology Plastic Engineering Paper & Pulp Technology Polymer Technology
Information Technology Computer Science & Engineering CSE (Internet of Things & Cyber security including Block chain Technology) Artificial Intelligence and Machine Learning	Computer Science and Engineering Computer Technology Electrical and Electronics Engineering Electronics & Communication Engineering Electronics & Instrumentation Engineering Instrumentation Engineering / Technology Information Technology
Food Technology	Biotechnology Food Technology B.Sc. Bio Science B.Sc. Bio Chemistry Chemical Technology Agriculture Engineering and Farming

Curriculum for

B.Tech.

(Artificial Intelligence and Machine Learning)

With effect from 2022-23

PONDICHERRY UNIVERSITY
CURRICULUM
B.Tech. (Artificial Intelligence and Machine Learning)

ACADEMIC YEAR 2022-23

I SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
	Induction Programme	-	-	-	-	-	-	-
BSC101	Physics	4	1	-	3	25	75	100
BSC102	Mathematics I	4	1	-	4	25	75	100
ESC103	Basic Electrical and Electronics Engineering	3	1	-	3	25	75	100
	Practical							
BSP101	Physics Lab	-	-	3	2.5	50	50	100
ESP102	Electrical and Electronics Engineering Lab	-	-	3	2	50	50	100
ESP103	Engineering Graphics & Design	-	-	3	3	50	50	100
	Total	**11**	**3**	**9**	**17.5**	**225**	**375**	**600**

II SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
BSC201	Chemistry	3	1	-	3	25	75	100
BSC202	Mathematics – II	4	1	-	4	25	75	100
ESC203	Programming for Problem Solving	4	1	-	3	25	75	100
HSC204	Communicative English	3	-	-	3	25	75	100
	Practical							
BSP201	Chemistry Lab	-	-	3	2.5	50	50	100
ESP202	Programming Lab	-	-	3	2	50	50	100
ESP203	Workshop/Manufacturing Practices	-	-	3	3	50	50	100
HSP204	NSS / NCC *	-	-	-	-	-	-	-
	Total	**14**	**3**	**9**	**20.5**	**250**	**450**	**700**

***Mandatory Course**

BSC-Basic Science Course, BSP-Basic Science Practical, ESC-Engineering Science Course, ESP- Engineering Science Practical, HSC-Humanities and Science Course, HSP- Humanities and Science Practical

III SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
AI EC301	Digital Circuit and Microprocessor	3	1	-	3	25	75	100
AI PC302	Data Structures	3	1	-	3	25	75	100
AI PC303	Python Programming	3	1	-	3	25	75	100
AI PC304	Principles of Artificial Intelligence	3	1	-	3	25	75	100
AI BS305	Discrete Mathematics	3	1	-	3	25	75	100
AI HS306	Professional Ethics & Human Values	3	-	-	3	25	75	100
	Practical							
AI CP301	Digital Circuit and Microprocessor Lab	-	-	3	1.5	50	50	100
AI CP302	Data Structures Lab	-	-	3	1.5	50	50	100
AI CP303	Python Programming Lab	-	-	3	1.5	50	50	100
	Total	**18**	**5**	**9**	**22.5**	**300**	**600**	**900**

IV SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
AI EC401	Operating Systems	3	1	-	4	25	75	100
AI PC402	Computer networks	3	1	-	4	25	75	100
AI EC501	Database Management Systems	3	1	-	3	25	75	100
AI PC404	Artificial Neural Networks	3	1	-	3	25	75	100
AI HS405	Organizational Behaviour	3	1	-	3	25	75	100
	Practical							
AI CP401	Operating Systems Lab	-	-	3	1.5	50	50	100
AI CP402	Computer networks Lab	-	-	3	1.5	50	50	100
AI CP501	DBMS Lab	-	-	3	1.5	50	50	100
AI BS404	Physical Education /Value Education	-	-	-	0	-	-	-
	Total	**15**	**5**	**9**	**22.5**	**275**	**525**	**800**

V SEMESTER

Code	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
AI PC501	Knowledge Representation and Reasoning	3	1	-	4	25	75	100
AI PC502	Fundamentals of Machine Learning	3	1	-	3	25	75	100
AI PC503	Probability and Statistics for Engineers	3	1	-	3	25	75	100
AI PC504	Data Visualization	3	1	-	3	25	75	100
AI HS505	Industrial Psychology	3	1	-	3	25	75	100
	Professional Elective-I	3	-	-	3	25	75	100
	Practical							
AI CP501	Expert System Lab	-	-	3	1.5	50	50	100
AI CP502	Machine Learning Lab	-	-	3	1.5	50	50	100
AI CP503	Statistics Lab (R and SPSS)	-	-	3	1.5	50	50	100
AI BS504	Value Addition Course	-	-	-	0	-	-	-
AI IV505	Internship/Online Certification	-	-	-	2	100	-	100
	Total	**18**	**5**	**09**	**24.5**	**400**	**600**	**1000**

***Internship/Online Certification**
Internship - Internship with minimum 4 weeks.
Online Certification - Minimum 12 weeks with Proctored Examination.

V Semester Professional Electives

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
AI PE501	Object Oriented Programming	3	-	-	3	25	75	100
AI PE502	Web Technology	3	-	-	3	25	75	100
AI PE503	Data Analytics	3	-	-	3	25	75	100

VI SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
AI PC601	Deep Learning Techniques	3	1	-	3	25	75	100
AI PC602	Data Science	3	1	-	3	25	75	100
	Professional Elective-II	3	-	-	3	25	75	100
	Professional Elective-III	3	-	-	3	25	75	100
***	Open Elective-I	3	-	-	3	25	75	100
	Practical							
AI CP601	Deep Learning Lab	-	-	3	1.5	50	50	100
AI CP602	Data Science Lab	-	-	3	1.5	50	50	100
AI PV603	Mini Project	-	-	6	3	50	50	100
	Total	**15**	**02**	**12**	**21**	**325**	**475**	**800**

VI Semester Professional Electives

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
AI PE601	Design of Modern Heuristics	3	-	-	3	25	75	100
AI PE602	Evolutionary Computation	3	-	-	3	25	75	100
AI PE603	Computational Intelligence	3	-	-	3	25	75	100
AI PE604	Software Engineering	3	-	-	3	25	75	100
AI PE605	Cognitive Science	3	-	-	3	25	75	100
AI PE606	Optimization Techniques	3	-	-	3	25	75	100

VII SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
AI PC701	Theory of Computation	3	-	-	3	25	75	100
	Professional Elective-IV	3	-	-	3	25	75	100
	Professional Elective-V	3	-	-	3	25	75	100
***	Open Elective-II	3	-	-	3	25	75	100
AI BS705	Biology for Engineers	3	-	-	3	25	75	100
	Practical							
AI PV701	Project Work-I	-	-	6	6	50	50	100
AI IV702	Industrial Visit/Training	-	-	-	1	100	-	100
	Total	**15**	**-**	**06**	**22**	**275**	**425**	**700**

VII Semester Professional Electives

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
AI PE701	Nature inspired Computing	3	-	-	3	25	75	100
AI PE702	Natural Language Processing	3	-	-	3	25	75	100
AI PE703	Deep Reinforcement Learning	3	-	-	3	25	75	100
AI PE704	AI for Robotics	3	-	-	3	25	75	100
AI PE705	Multimodal Sentiment Analysis	3	-	-	3	25	75	100
AI PE706	Computational Biology	3	-	-	3	25	75	100

VIII SEMESTER

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
	Professional Elective-VI	3	-	-	3	25	75	100
***	Open Elective-III	3	-	-	3	25	75	100
***	Open Elective-IV	3	-	-	3	25	75	100
	Practical							
AI PV801	Project Work-II	-	-	6	6	50	50	100
	Total	09	-	06	15	125	275	400

VIII Semester Professional Electives

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
AI PE801	Data Mining and warehousing	3	-	-	3	25	75	100
AI PE802	Business intelligence and analytics	3	-	-	3	25	75	100
AI PE803	C# and Dot Net Programming	3	-	-	3	25	75	100
AI PE804	Virtual Reality and Augmented Reality	3	-	-	3	25	75	100
AI PE805	Big Data Analytics for IoT	3	-	-	3	25	75	100
AI PE806	Information Security	3	-	-	2	25	75	100

OPEN ELECTIVES

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
AI OE901	Bio Informatics	3	-	-	3	25	75	100
AI OE902	Cloud Computing	3	-	-	3	25	75	100
AI OE903	Fog and Edge Computing	3	-	-	3	25	75	100
AI OE904	Wireless Computing	3	-	-	3	25	75	100
AI OE905	Pervasive Computation	3	-	-	3	25	75	100
AI OE906	Mobile Computing	3	-	-	3	25	75	100
AI OE907	Software Testing	3	-	-	3	25	75	100
AI OE908	Software Project Management	3	-	-	3	25	75	100
AI OE909	Graph Theory and Its Application	3	-	-	3	25	75	100
AIOE910	Blockchain Technology	3	-	-	3	25	75	100
AI OE911	Graphics and Multimedia	3	-	-	3	25	75	100
AI OE912	Social and Ethical Issues	3	-	-	3	25	75	100

Summary of all Courses

B.Tech ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING										
Sl.No.	**Course Category**	**Credits per semester**								
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**TOTAL**
1	**BSC**	7	7	3	-	-	-	-	-	**17**
2	**ESC**	3	3	-	-	-	-	-	-	**06**
3	**ESP**	5	5	-	-	-	-	-	-	**10**
4	**BSP**	2.5	2.5	-	-	-	-	-	-	**05**
5	**HSC**	-	3	-	-	-	-	-	-	**03**
6	**HSP**	-	0	-	-	-	-	-	-	**0**
7	**BS**	-	-	3	0	0	-	3	-	**06**
8	**EC**	-	-	3	4	3	-	-	-	**10**
9	**PC**	-	-	9	11	9	6	3	-	**38**
10	**HS**	-	-	3	3	3	-	-	-	**09**
11	**PE**	-	-	-	-	3	6	6	3	**18**
12	**OE**	-	-	-	-	-	3	3	6	**12**
13	**CP**	-	-	4.5	4.5	4.5	3	-	-	**16.5**
14	**IV**	-	-	-	-	2	-	1	-	**03**
15	**PV**	-	-	-	-	-	3	6	6	**15**
	TOTAL	**17.5**	**20.5**	**25.5**	**22.5**	**24.5**	**21**	**22**	**15**	**168.5**

I SEMESTER

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
BCS101	**PHYSICS**	**3**	**1**	**-**

Course Pre-requisite

- Fundamental knowledge of Physics

Course Objectives

- To demonstrate skills in scientific inquiry, problem solving and Lab techniques
- To demonstrate competency and understanding of the concepts found in Quantum Mechanics
- To gain knowledge of Fiber optics and lasers, Semiconductor physics and Electromagnetic theory
- The graduates will be able to solve non-traditional problems
- To study applications in engineering like memory devices, transformer core and electromagnetic machinery

Course Outcomes

- To learn the fundamental concepts on Quantum behavior of matter in its micro state
- Knowledge of fundamentals of Semiconductor physics, Optoelectronics, Lasers and fiber optics
- To apply to various systems like communications, solar cell, photo cells and so on
- Design, characterization and study of properties for various engineering applications
- The course also helps the students to be exposed to the phenomena of electromagnetism and also to have exposure on magnetic materials and dielectric materials

UNIT I – Quantum Mechanics: Introduction to quantum physics, Black body radiation, Planck's law, Photoelectric effect, Compton effect, de-Broglie's hypothesis, Wave-particle duality, Davisson and Germer experiment, Heisenberg's Uncertainty principle, Born's interpretation of the wave function, Schrodinger's time independent wave equation, Particle in one dimensional box.

UNIT II – Semiconductor Physics: Intrinsic and Extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature, Carrier generation and recombination, Carrier transport: diffusion and drift, Hall effect, pn junction diode, Zener diode and their V-I Characteristics, Bipolar Junction Transistor (BJT):Construction, Principle of operation.

UNIT III – Optoelectronics: Radiative and non-radiative recombination mechanisms in semiconductors, LED and semiconductor lasers: Device structure, Materials, Characteristics and figures of merit, Semiconductor photodetectors: Solar cell, PIN and Avalanche and their structure, Materials, working principle and Characteristics.

UNIT IV – Lasers and Fibre Optics and Lasers: Introduction to interaction of radiation with matter, Coherence, Principle and working of Laser, Population inversion, Pumping, Types of Lasers: Ruby laser, Carbon dioxide (CO_2) laser, He-Ne laser, Applications of laser.Fibre Optics: Introduction, Optical fibre as a dielectric wave guide, Total internal reflection, Acceptance angle, Acceptance cone and Numerical aperture, Step and Graded index fibers, Losses associated with optical fibres, Applications of optical fibers.

UNITV – Electromagnetism and Magnetic Properties of Materials: Laws of electrostatics, Electric current and the continuity equation, Ampere's and Faraday's laws, Maxwell's equations, Polarisation, Permittivity and Dielectric constant, Internal fields in a solid, Clausius- Mossotti equation, Ferroelectrics and Piezoelectrics, Ferromagnetism and ferromagnetic domains, Hysteresis, Applications of magnetic materials.

TOTAL PERIODS: 60

Text Books

1. B.K. Pandey, S. Chaturvedi, "Engineering Physics", 2nd Edition, Cengage Learing, 2022.
2. Halliday and Resnick, "Fundamentals of Physics", 12th Edition, Wiley, 2021.
3. Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar, "A Textbook of Engineering Physics", Revised Edition, S. Chand & Co Ltd., 2014.

Reference Books

1. Richard Robinett, "Quantum Mechanics", 2nd Edition, Oxford University Press, 2006.
2. Jasprit Singh, "Semiconductor Optoelectronics: Physics and Technology", Mc Graw-Hill (1995).

Content Beyond Syllabus

- Design of semiconductor devices

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
BSC102	MATHEMATICS -I	3	1	-

Course Pre-requisite

- Basic Concepts of Calculus, Vector Calculus

Course Objectives

- Understand the concept of differentiation
- Interpret in the area of infinite series and their convergence
- Evaluate the functions of several variables which needed in branches of engineering
- Understand the concept of double integrals
- Understand the concept of triple integrals

Course Outcomes

- Apply the concept of differentiation in any curve
- Evaluation of infinite series approximations for problems arising in mathematical modeling
- Identify the maximum and minimum values of surfaces
- Apply double integrals to compute the area of plane curves
- Evaluation of triple integrals to compute the volume of solids

UNIT I – Differential Calculus: Rolle's Theorem – Lagrange's Mean Value Theorem- Maxima and Minima - Taylor's and Maclaurin's Theorem.

UNIT II – Sequence and Series: Definition and examples – Series – Test for Convergence – Comparison Test – D' Alembert's Ratio Test – Alternative Series – Alembert's Leibnitz test.

UNIT III – Multivariate Calculus: Total derivatives - Jacobians – Maxima, Minima, and Saddle points - Lagrange's method of undetermined multipliers – Gradient, divergence, curl, and derivatives.

UNIT IV – Double Integration: Double integrals in Cartesian coordinates – Area enclosed by the plane curves (excluding surface area) – Green's Theorem (Simple Application) - Stoke's Theorem – Simple Application involving cubes and rectangular parallelopiped.

UNIT V – Triple Integration: Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates-Gauss Divergence Theorem – Simple Application involving cubes.

TOTAL PERIODS: 60

Text Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2020.
2. Veerarajan T, "Engineering Mathematics", McGraw Hill Education (India) Pvt Ltd, New Delhi, 2016.

Reference Books

1. Weir,M.D and Joel Hass, 'Thomas Calculus" 12th Edition,Pearson India 2016.
2. Grewal B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, New Delhi, 2018.

Content Beyond Syllabus

- Applying on real time problems

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
ESC103	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	3	1	-

Course Pre-requisite

- Fundamental knowledge of Physics

Course Objectives

- To knowledge of fundamental concepts of basic electrical and electronics engineering
- Understanding of D.C and A.C fundamentals, A.C circuits, electrical machines, electronic circuits, digital electronics and communication engineering
- To gain knowledge about power plants and its working principle
- To understand concepts in conductors and transistors
- To know about Fundamentals of communication theory concepts

Course Outcomes

- Apply the Kirchhoff's law, concept of series and parallel resistance, nodal and mesh analysis to solve the DC circuits
- Determine the average, rms, form and peak factor of various waveforms and solve the RL, RC and RLC Series circuits
- Explain the working principle of diode, transistor, FET and analyze its characteristics curves
- Also extends it on rectifiers, amplifiers and oscillator applications
- Microwave, satellite, optical fiber and cellular mobile system

UNIT I – DC Circuits: Definition of Voltage, Current, Power & Energy, circuit parameters, Ohm's law, Kirchoff's law & its applications – Simple Problems - Series & parallel connected circuits - star/delta conversion - Node and mesh methods of analysis of DC circuits.

UNIT II – AC Circuits: Concepts of AC circuits – rms value, average value, form and peak factors– Simple RL, RC ,RLC series circuits and Problems – Concept of real and reactive power – Power factor - Introduction to three phase system - Power measurement by two wattmeter method.

UNIT III – Electrical Machines And Power Plant: Electromechanical Energy Conversion - Law of Electromagnetic induction, Fleming's Right & Left hand rule - Principle of DC rotating machine, Single phase transformer - single phase induction motor (Qualitative approach only) - Simple layout of thermal and hydro generation (block diagram approach only).

UNIT IV – Electronic Circuits: Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type - V-I Characteristics of diode - Half-wave rectifier and Full-wave rectifier – with and without capacitor filter - Transistor –Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics - Transistor as an Amplifier - Principle and working of Hartley oscillator and RC phase shift oscillator - Construction and working of JFET & MOSFET.

UNIT V – Digital Electronics &Fundamentals Of Communication Theory: Boolean algebra – Reduction of Boolean expressions - De-Morgan's theorem – Logic gates -Implementation of Boolean expressions - Flip flops - RS, JK, T and D. Combinational logic - Half adder, Full adder and Subtractors, Sequential logic - Ripple counters and shift registers. Model.

TOTAL PERIODS: 60

Text Books

1. Kothari D P and Nagrath I J, "Basic Electrical Engineering", Tata McGraw Hill, 2009.
2. S.K. Sahdev, "Fundamentals of Electrical Engineering and Electronics", Dhanpat Rai & Co, 2013.
3. Morris Mano, "Digital design", PHI Learning, Fourth Edition, 2008.
4. Rajendra Prasad, "Fundamentals of Electronic Engineering", Cengage learning, New Delhi, First Edition, 2011.
5. Wayne Tomasi, "Electronic Communication Systems- Fundamentals Theory Advanced", Fourth Edition, Pearson Education, 2001.

Reference Books

1. R.Muthusubramaniam, S.Salivahanan and K.A. Mureleedharan, "Basic Electrical Electronics and Computer Engineering", Tata McGraw Hill, 2004.
2. J.B.Gupta, "A Course in Electrical Power", Katson Publishing House, New Delhi, 1993.
3. David. A. Bell, "Electronic Devices and Circuits", PHI Learning Private Ltd, India, Fourth Edition, 2008.
4. Donald P Leach, Albert Paul Malvino and Goutam Saha, "Digital Principles and Applications," 6th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.

Content Beyond Syllabus

- Design of circuits over real time applications

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
BSP101	PHYSICS LAB	-	-	3

Course Pre-requisite

- Fundamental knowledge of physics

Course Objectives

- To improve the knowledge about the theory learned in the class.
- To improve ability to analyze experimental result and write Labreport
- To impart physical measurements skills
- To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipments
- Design of circuits using new technology and latest components and to develop practical applications of engineering materials

Course Outcomes

- State various laws which they have studied through experiments
- Describe principles of optical fibre communication
- Develop skills to impart practical knowledge in real time solutions
- Understand principle, concept, working and applications of new technology and comparison of results with theoretical calculations
- Understand measurement technology, usage of new instruments and applications in engineering studies

LIST OF EXPERIMENTS

1. Energy gap of P-N junction diode: To determine the energy gap of a semiconductor diode.
2. Solar Cell: To study the V-I Characteristics of solar cell.
3. Light emitting diode: Plot V-I and P-I characteristics of light emitting diode.
4. Stewart – Gee's experiment: Determination of magnetic field along the axis of a current carrying coil.
5. Hall Effect: To determine Hall co-efficient of a given semiconductor.
6. Photoelectric effect: To determine work function of a given material.
7. LASER: To study the characteristics of LASER sources.
8. Optical fibre: To determine the bending losses of Optical fibres.
9. LCR Circuit: To determine the Quality factor of LCR Circuit.
10. R-C Circuit: To determine the time constant of R-C circuit.

TOTAL PERIODS: 45

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
ESP102	ELECTRICAL AND ELECTRONICS ENGINEERING LAB	-	-	3

Course Pre-requisite

- Fundamental knowledge Electrical and Electronics

Course Objectives

- To understand about magnetic and electrical circuits, single and three phase power measurement
- To understand operating principles of stationary and rotating machines
- To understand the basic operation, functions and applications of PN junction diode, transistor, logic gates and flip flops
- To gain knowledge on various communication systems and network models and the use of ISDN
- To Gain basic knowledge of DC circuits

Course Outcomes

- Acquire knowledge about the single phase and three base electrical circuits
- Gain knowledge on operating principles of rotating machines and general structure of power systems
- Understand the basic operation and applications of PN junction diode, transistor and oscillators
- Acquire knowledge on logic gates, flip flops, shift registers and counters
- Gain knowledge on various communication systems and network models and the use of ISDN

LIST OF EXPERIMENTS

ELECTRICAL LAB

1. Electrical Safety, Precautions, study of tools and accessories.
2. Practices of different joints.
3. Wiring and testing of series and parallel lamp circuits.
4. Staircase wiring.
5. Doctor's room wiring.
6. Bed room wiring.
7. Godown wiring.
8. Wiring and testing a ceiling fan and fluorescent lamp circuit.
9. Study of different types of fuses and AC and DC meters.

ELECTRONICS LAB

1. Study of CRO
2. Measurement of AC and DC voltages
3. Frequency and phase measurements (using Lissajou'sfigures)
4. Verification of Kirchoff's Voltage and Current Laws
5. Determine the voltage and current in given circuits using Kirchoff"s law theoretically and verify the laws experimentally.
6. Characteristics and applications of PN junction diode.
7. Forward and Reverse characteristics of PN junction diode.
8. Application of Diode as Half wave Rectifier – Measurement of ripple factor with and without capacitor filter
9. Frequency Response of RC Coupled Amplifiers
10. Determination of frequency response of given RC coupled amplifier – Calculation of bandwidth.
11. Study of Logic Gates
12. Verification of Demorgan's theorems
13. Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR,
14. EX-NOR gates and Flipflops - JK, RS, T and D
15. Implementation of digital functions using logic gates and Universal gates.

TOTAL PERIODS: 45

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
ESP103	**ENGINEERING GRAPHICS &DESIGN**	**-**	**-**	**3**

Course Pre-requisite

- Basic knowledge in mathematics

Course Objectives

- Drawing free hand sketches of basic geometrical shapes and multiple views of object
- Drawing orthographic projections of lines and planes
- Drawing orthographic projections of solids
- Drawing development of the surfaces of objects
- Drawing isometric and perspective views of simple solids

Course Outcomes

- Use the drawing instruments effectively and able to dimension the given figures
- Appreciate the usage of engineering curves in tracing the paths of simple machine components
- Understand the concept of projection and acquire visualization skills, projection of points
- Able to draw the basic views related to projections of Lines, Planes
- Draw projections and solids and development of surfaces

UNIT I – Plane Curves And Free Handsketching: Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by different methods – Construction of cycloid – construction of involutes, spiral and helix.

UNIT II – Projection Of Points Lines And Plane Surfaces: Orthographic projection- principles-Principle planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes- Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes.

UNIT III – Projection Of Solids: Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

UNIT IV – Section Of Solids: Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

UNIT V – Development Of Surfaces And Isometric Projections: Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs. Principles of isometric projection– isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones.

TOTAL PERIODS: 60

Text Books

1. Bhatt, N.D.,Panchal V M and Pramod R. Ingle, "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2014.
2. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015.

Reference Books

1. Agrawal, B. and Agrawal C.M., "Engineering Drawing", Tata McGraw, New Delhi, 2008.
2. Gopalakrishna, K. R., "Engineering Drawing",Subhas Stores, Bangalore, 2007.
3. Natarajan, K. V., "A Text book of Engineering Graphics", 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
4. Shah, M. B., and Rana, B. C., "Engineering Drawing", Pearson, 2nd Edition, 2009.
5. Venugopal, K. and Prabhu Raja, V., "Engineering Graphics", New Age, 2008.
6. K.V. Natarajan, "A Text Book of Engineering Drawing", Dhanalakshmi Publishers, 2006.

Content Beyond Syllabus

- Design Using AUTOCAD Software

II SEMESTER

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
BSC201	CHEMISTRY	3	1	-

Course Pre-requisite

- To develop basic ideas on electrochemistry, polymer chemistry, water technology etc

Course Objectives

- To know about the importance and applications of Chemistry in Engineering disciplines
- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques
- To understand the importance of the chemical approach to polymers and the mechanisms, techniques used to achieve polymerization of higher molecular weight polymers
- To understand the basic electrochemical principles involving the production and storage of electrical energy by the chemical reactions
- To understand the chemical and electrochemical corrosion nature of metals and the protective methods

Course Outcomes

- Identify cause and factors which can adversely affecting natural water quality and apply knowledge to adapt the techniques available for water purification
- Explain the synthesis of various polymers and select polymer/rubber/plastic materials for engineering applications
- Know the principles of electrochemistry and apply in understanding the working of energy storage devices
- Explain chemical nature and causes of corrosion, and apply correct and efficient methods of corrosion prevention
- Gain the knowledge on nano materials to facilitate better understanding the properties of size reduced components

UNIT I – Water Technology: Hardness of water – units and calcium carbonate equivalent. Determination of hardness of water-EDTA method. Disadvantages of hardwater-boiler scale and sludge, caustic embrittlement, priming & foaming and boiler corrosion. Water softening method – internal & external conditioning – zeolite process and ion exchange process. Desalination – reverse osmosis & electro dialysis.

UNIT II – Polymer Chemistry: Classification-Natural and synthetic; Thermoplastic and Thermosetting, Functionality – Degree of polymerization. Types of polymerization reactions - mechanism of radical, ionic polymerizations. Polymer properties - Crystalinity, Tg, Tacticity, Mn and Mw, Preparation, properties and uses of PVC, TEFLON, Nylons, Bakelite, epoxy resin. Rubbers - vulcanization, synthetic rubber, buna S, buna N and butyl rubber. Polymerization techniques - bulk, suspension, emulsion, solution and gas phase polymerization. Moulding Techniques,Compression, injection and Extrusion Moulding, Conducting polymers - classification and applications. Polymer composites – FRP, Bullet Proof Plastics.

UNIT III – Electrochemical Cells: Galvanic cells, single electrode potential, standard electrode potential, electromotive series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes-hydrogen calomel, & glass electrodes. Batteries - primary and secondary cells, laclanche cell, alkaline battery, lead acid storage cell, Li ion &Ni- Cd battery, Fuel cells - H2-O2 fuel cell.

UNIT IV – Corrosion and Its Control: Chemical & electrochemical corrosion-Galvanic series- galvanic, pitting, stress and concentration cell corrosion. Factors influencing corrosion-corrosion control methods - cathodic protection and corrosion inhibitors. Protective coating - types of protective coatings-metallic coating-tinning and galvanizing, cladding, electroplating and anodizing.

UNIT V – Nanochemistry: Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: nano cluster, nano rod, nanotube (CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrode position, chemical vapour deposition, laser ablation; Properties and applications.

TOTAL PERIODS: 60

Text Books

1. P.C. Jain and Monika Jain, "Engineering Chemistry", Dhanpat Rai and Sons, New Delhi 2004.
2. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, "Engineering Chemistry", 2nd edition. PHI Learning PVT., LTD, New Delhi, 2008.

Reference Books

1. S. S. Dara, "A Textbook of Engineering Chemistry", S. Chand & Co., Ltd. New Delhi.
2. B. K. Sharma, "Engineering Chemistry", 3rd edition Krishna Prakashan Media (P) Ltd., Meerut, 2001.

Content Beyond Syllabus

- Chemistry in Industry
- Applications of Nanomaterials

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
BSC202	MATHEMATICS -II	4	1	-

Course Pre-requisite

- Matrices and Determinants, Differential Equations

Course Objectives

- To use matrix algebra techniques that are needed by engineers for Practical applications
- Extend the knowledge of vector spaces
- Describe some methods to solve different types of first-order differential equations
- Solve ordinary differential equations of certain types using the Wronskian technique
- Use effective mathematical tools for the solutions of partial differential equations

Course Outcomes

- Calculate Eigen values and Eigen vectors for a matrix
- Infer the knowledge of vector spaces
- Apply a few methods to solve different types of first-order differential equations
- Develop a sound knowledge of techniques in solving ordinary differential equations
- Solve Partial Differential Equations using various methods

UNIT I – Matrices: Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors (without proof) Cayley - Hamilton Theorem (excluding proof) - Orthogonal matrices – Definition – Reduction of a quadratic form to canonical form by orthogonal transformation.

UNIT II – Vector Spaces: Complex matrices – Conjugate of the matrix – Hermitian and Skew Hermitian matrices – Properties (without proof) – Unitary matrix – Properties (without proof) - Inner product spaces – Gram – Schmidt orthogonalization.

UNIT III – First Order Ordinary Differential Equations: Equations of the first order and of the first degree – Homogeneous equations – Exact differential equations – Linear equations – Equations reducible to the linear form – Bernoulli's equation.

UNIT – Ordinary Differential Equations of Higher Order: Second order linear differential equations with constant and variable coefficients – Cauchy – Euler equations – Cauchy – Legendre equation – Method of variation of parameters.

UNIT V – Partial Differential Equations: Formation of partial differential equations by the elimination of arbitrary constants and arbitrary functions – Solution of standard types of first- order partial differential equations of the form f(p,q)=0, Clairaut's type : z = px+qy +f(p,q) – Lagrange's linear equation.

TOTAL PERIODS: 60

Text Books

1. Grewal B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, New Delhi, 2018.
2. Howard Anton, Chris Rorres, "Elementary Linear Algebra", Wiley, New Delhi, 9th Edition, 2006.

Reference Books

1. E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
2. G.F.Simmons and S. G. Krantz, "Differential Equations", Tata McGraw Hill, 2007.
3. Veerarajan T, "Engineering Mathematics", McGraw Hill Education (India) Pvt Ltd, New Delhi, 2016.

Content Beyond Syllabus

- Application of Principle Component Analysis for Digital Image Processing applications

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
ESC203	PROGRAMMING FOR PROBLEM SOLVING	4	1	-

Course Pre-requisite

- Fundamental knowledge in Mathematics
- Knowledge in Computer fundamental

Course Objectives

- To introduce the basics of computers and information technology
- To educate problem solving techniques
- To impart programming skills in C language
- To practice structured programming to solve real life problems
- To understand File Operations concepts

Course Outcomes

- Have Knowledge on evolution, classification , components of computers and its applications, have an awareness of internet, intranet and network structures, create files on MS office word and excel
- Apply problem solving techniques like algorithm, flowchart and pseudo code on real life problems; summarize 7 phases of program development cycle, basic tokens of C program, its structure, I/O functions
- Apply decision making and looping statements in real life problems; Usage of arrays, functions, storage classes and string functions
- Familiar on usage of structures, pointers and its manipulation
- Describe and infer about Preprocessors, command line arguments and various file operations

UNIT I – Introduction: History of Computers – Block diagram of a Computer – Components of a Computer system – Classification of computers - Hardware – Software – Categories of Software – Operating System – Applications of Computers – Network Structure– Internet and its services – Intranet – Study of word processor – Preparation of worksheets - Algorithm –Pseudo code – Flow Chart .

UNIT II – C Programming Basics: Problem formulation – Problem Solving – Introduction to ' C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types –Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III – Array, String And Functiions: Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations- Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion.

UNIT IV – Structure And Unions: Pointers – Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems. Structures – need for structure data type – structure definition – Structure declaration – Structure within a structure – Union – Programs using structures and Unions – Storage classes.

UNIT V – Files: operations on a file – Random access to files – command line arguments Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives .

TOTAL PERIODS: 60

Text Books

1. Ashok N Kamthane," Computer Programming", Pearson Education, 2nd impression, 2008.

Reference Books

1. Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, 6th Edition, 2012.
2. Vikas Verma, "A book on C", Cengage learning, 2nd edition 2012.

Content Beyond Syllabus

- Programs for Scientific and Engineering Applications

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
HSC204	COMMUNICATIVE ENGLISH	3	-	-

Course Pre-requisite

- Knowledge in English Language, vocabulary

Course Objectives

- To learn correct pronunciation, spelling, meaning and usage of English Vocabularies
- To simulate real life situations in the classroom to practice real English dialogues and speeches to gain English language fluency
- To engage in the pragmatic and functional use of language
- To build and enrich their communication skills
- To develop the ability to understand English in a wide range of context

Course Outcomes

- Understand the importance of professional communication and applying the knowledge
- Integrate the knowledge of phonetics, enhancing the listening skills in formal and real life situations; enhance pronunciation skills based on the knowledge of phonetics
- Applying grammatical rules and developing reading skills, derive the contextual meaning, case studies and analyzing problems
- Integrate creativity in the writing skills both in formal and informal situations, related to environment, society and multidisciplinary environments
- Imbibe soft skills to excel in interpersonal skills essential for the workplace

UNIT I – The Fundamentals Of Communication: Importance of communication through English – Process of communication and factors that influence speaking – Importance of audience and purpose – Principles of Communication – comparing general communication and business communication – Professional communication – barriers to communication – strategies to overcome communication barriers - formal and informal communication. Suggested Activities: Self – Introduction-short Conversations-Situational communication- dialogue writing – Language Functions-analyze the speech and comment – distinguish formal and informal style of communication –using bias-free language-news reports.

UNIT II – Aural – Oral Communication In English: Vowels-diphthongs- consonants- International Phonetic Alphabet (IPA); phonemic transcription (simple words) – syllable division and word stress – enunciation- GIE script (General Indian English) – neutral accent- sentence rhythm and weak forms-contrastive stress in sentences to highlight different words-intonation varieties of Spoken English: Standard India, American and British -Speaking to communicate - speech acts - Language patterns. Suggested Activities: (Audio) Listen and repeat, listen to the sentences and fill in the blanks, listen to passages and answering questions, marking the stressed syllable, phonemic script of simple words, sentence rhythm and intonation (rising and falling tone), short speeches.

UNIT III – Development of Reading Skills: Sentence pattern-Interrogative, Articles, Pronouns and determiners-Vocabulary –word formation: prefixes and suffixes, reading passages-inductive vs. deductive reading – newspaper articles-comprehension passages-cloze reading-editing Suggested Activities: Reading technical passages based on students area of specialization answering questions-reading passage for identifying the contextual meaning-identify the errors on sentences

UNIT IV – Effective Reading And Business Communication: Paragraph writing - topic sentence - connectives - process writing - Memoranda - Business letters- Resumes/Visumes and job applications - drafting a report - agenda and minutes of the meeting – email etiquette-interpreting visual data (bar chart, pie chart, and line graphs). Suggested Activities: Writing short paragraphs based on environment protection, health, cultural contexts etc., Identifying topic sentences, linking pairs of sentences, formal letters, e-mails, Drafting project proposals and minutes of meeting.

UNIT V – Soft Skills: Introducing Soft Skills & Life Skills – Myers Briggs Type Indicator – the Big Five

Model Personality – Employability Skills – Workplace Etiquette – Professional Ethics – Time Management – Stress Management – Lateral Thinking (De Bono's Six Thinking Hats) and Problem Solving Skills. Suggested Activities: Mock interviews & Group Discussion, oral presentation, lateral thinking puzzles, self-study assignments & Worksheet activities.

TOTAL PERIODS: 60

Text Books

1. Dr. Bikram K. Das et.al., "An Introduction to Profession English and Soft Skills with audio CD", Published by Cambridge University Press, 2009.

Reference Books

1. Sabina Pillai and Agna Fernandez, "Soft Skills & Employability Skills", Cambridge University Press, 2018.
2. Steve Hart et al. "Embark, English for Undergraduates", Cambridge University Press, 2016
3. Collins, "Skills for the TOEFL IBT Test", 2012.
4. Jeff Butterfield "Soft Skills for Everyone", Cengage Learning, 2010.
5. Dolly John, "English for life and the workplace Through LSRW&T skills" Pearson Publications, 2014.
6. ArunaKoneru, "Professional Speaking Skills", Oxford Publications, 2015.
7. Ian Mackenzie, "English for Business Studies", 3rd Edition, Cambridge University Press, 2008.
8. Dr.P.K.Manoharan, "Education and Personality Development", APH Publishing Corporation, 2015.

Content Beyond Syllabus

- Business communication
- Critical Reading and Creative writing skills
- Employability Skills

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
BSP201	CHEMISTRY LAB	-	-	3

Course Pre-requisite

- Fundamental knowledge in Chemistry

Course Objectives

- To gain a practical knowledge of Chemistry in relevance to Industrial applications
- Provide the students with a solid foundation in Chemistry laboratory required to solve engineering problems
- Practical implementation of fundamental concepts
- To familiarize the students with different application-oriented topics like new generation engineering materials, storage devices, different instrumental methods etc
- To develop abilities and skills that is relevant to the study and practice of chemistry

Course Outcomes

- Students will become well acquainted to test amount of hardness present in sample of water for their engineering needs
- Students will be efficient in estimating acidity/alkalinity in given samples
- Students will have knowledge about estimating amount of dissolved oxygen in water
- Students will become well acquainted to estimate copper in brass
- Students will have knowledge about determination of viscosity of sucrose using Ostwald's viscometer

LIST OF EXPERIMENTS

1. Estimation of HCl using Na2CO3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler‟s method.
4. Estimation of copper content of the given solution by Iodometry.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Determination of strength of acids in a mixture of acids using conductivity meter.
7. Estimation of iron content of the given solution using potentiometer.
8. Estimation of iron content of the water sample using spectrophotometer (1, 10 Phenanthroline / thiocyanate method).
9. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
10. Phase change in a solid.

TOTAL PERIODS: 45

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
ESP202	PROGRAMMING LAB	-	-	3

Course Pre-requisite

- Basics in computer knowledge, C, Microsoft

Course Objectives

- To develop programs in C using basic constructs
- To gain knowledge about Control Structures
- To develop applications in C using strings, pointers
- To develop program about functions and structures
- To develop applications in C using file processing

Course Outcomes

- Understood the program editing and compilation environment
- Able to write simple C programs using most frequently used control structures
- Apply the methods problems using arrays and functions
- Learnt to handle data processing using structures for simple applications
- Write programs that could handle file I/O and pointers

LIST OF EXPERIMENTS

1) Study of Compilation and execution of simple C programs
2) Basic C Programs
   a) Arithmetic Operations, Find area and circumference of a circle
   b) Swapping with and without Temporary Variables
3) Programs using Branching statements
   a) To check the number as Odd or Even
   b) Greatest of Three Numbers, Counting Vowels
   c) Grading based on Student's Mark
4) Programs using Control Structures
   a) Computing Factorial of a number
   b) Fibonacci Series generation
   c) Prime Number Checking, Computing Sum of Digit
5) Programs using Arrays
   a) Sum of 'n' numbers
   b) Sorting an Array
   c) Matrix Addition, Subtraction, Multiplication and Transpose
6) Programs using Functions
   a) Computing nCr
   b) Factorial using Recursion
   c) Call by Value and Call by Reference
7) Programs using String
   a) Operations a. Palindrome Checking
   b) Searching and Sorting Names
8) Programs using Structure
   a) Student Information System
   b) Employee Pay Slip Generation
   c) Electricity Bill Generation
9) Programs using Pointers
   a) Pointer and Array, Pointer and Structure
   b) Pointers as argument and return value
10) Programs using File Operation
   a) Counting No. of Lines, Characters and Black Spaces
   b) Content copy from one file to another, Reading and Writing Data in File

TOTAL PERIODS: 45

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
ESP203	WORKSHOP/ MANUFACTURING PRACTICES	-	-	3

Course Pre-requisite

- Basic knowledge of Physics

Course Objectives

- To convey the basics of mechanical tools used in engineering
- To establish hands on experience on the working tools
- To develop basic joints and fittings using the hand tools
- To establish the importance of joints and fitting in engineering applications
- To explain the role of basic workshop in engineering

Course Outcomes

- To convey the basics of mechanical tools used in carpentry section and establish hands on experience in making the different carpentry joints
- To gain knowledge on types of tools and machines used in sheet metal shop and perform some exercises
- To develop basic welding and fitting joints using the hand tools and establish the importance of joints and fitting in engineering applications
- To gain knowledge of the different machines used in manufacturing processes which are commonly employed in the industry, to fabricate components using different materials
- To carry out simple manufacturing operations in lathe, drilling and shaping machine

LIST OF EXPERIMENTS

I FITTING

Study of tools and Machineries. Exercises on symmetric joints and joints with acute angle

1. Study of tools and Machineries
2. Symmetric fitting
3. Acute angle fitting

II WELDING

Study of arc and gas welding equipment and tools – Edge preparation – Exercises on lap joint and V Butt joints –Demonstration of gas welding

1. Study of arc and gas welding equipment and tools
2. Simple lap welding (Arc)
3. Single V butt welding (Arc)

III SHEET METAL WORK

Study of tools and Machineries – exercises on simple products like Office tray and waste collection tray

1. Study of tools and machineries
2. Funnel
3. Waste collection tray

IV CARPENTRY

Study of tools and Machineries – Exercises on Lap joints and Mortise joints

1. Study of tools and machineries
2. Half lap joint
3. Corner mortise joint

TOTAL PERIODS: 45

III SEMESTER

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI EC301	**DIGITAL CIRCUIT AND MICROPROCESSOR**	**3**	**1**	**-**

Course Pre-requisite

- Fundamental knowledge on internal working of computers, programming and problem solving skill

Course Objectives

- To introduce the fundamentals of digital system design and computer design
- To gain knowledge in combinational logic circuit
- To lay strong foundation to the combinational and sequential logic
- To understand I/O interfacing, instruction set of 8085 Microprocessor
- To understand I/O interfacing, instruction set 8086 Microprocessor

Course Outcomes

- Test the Digital Systems, Logic Families and logic gates and construct combinational logical circuit and sequential logical circuit
- Understand working multiplexer and de multiplexer concepts
- Understand the working components of the microprocessors
- Develop assembly language programs, I/O interfacing using 8085
- Develop assembly language programs, I/O interfacing using 8086

UNIT I – Review of Binary number systems: Binary, Decimal, Octal, Hexadecimal number systems – Number base conversions – Signed binary numbers – Arithmetic operations – Binary codes– Boolean Algebra and Theorems, Sum of Products and Product of Sums functions, Minimization of expressions using Karnaugh Maps and Quine-McCluskey method.

UNIT II – Combinational Logic: Half and full adders/subtractors – Parallel Adders – Look- ahead carry adders - BCD adders/subtractors – Binary Multiplier – Code convertors – Decoders – Encoders – Parity encoders – Multiplexers – Implementation of combinational logic using Multiplexers - Demultiplexers-Magnitude comparators-Parity generator/checker. HDL for Combinational circuit.

UNIT III – Sequential Logic: Latches versus Flip Flops – SR, D, JK Flip Flops– Conversion of Flip flops – Counters: Asynchronous, synchronous– Shift Registers: types, applications. Reconfigurable Digital Circuits: Types of Memories – Organization of ROM and RAM – Programmable Logic Devices (PLDs) – Programmable Logic Arrays (PLAs) – Programmable Array Logic (PAL) devices – Field Programmable Gate Arrays (FPGAs).

UNIT IV – Intel 8085 Microprocessor: Introduction - Need for Microprocessors – Evolution – Intel 8085 Hardware Architecture – General Purpose and Special Purpose registers - Pin description – Instruction word size - Addressing modes – Instruction Set – Assembly Language Programming. Intel 8085 Interrupts: 8085 Interrupts – Software and Hardware Interrupts – 8259 Programmable Interrupt Controller

UNIT-V – I/O Interfacing: Memory and I/O interfacing - 8255 Programmable Peripheral Interface – 8251 USART, 8279 Keyboard/Display Interface. Intel 8086 Microprocessor: Introduction-Intel 8086 Hardware architecture – Pin-diagram description –Addressing modes - Instruction set.

TOTAL PERIODS: 60

Text Books

1. M. Morris Mano and Michael D. Ciletti, "Digital Systems: With an Introduction to the Verilog HDL", Fifth Edition, Prentice Hall of India, 2012.
2. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085", Penram International Publications, Fifth Edition, October 2013.

Reference Books

1. A. P. Godse and D. A. Godse, "Digital Systems Design", Technical Publications, Pune, 2008.
2. N. Senthil Kumar, M Saravanan and S. Jeevananthan, "Microprocessors and Microcontrollers", Oxford University Press, First Edition 2010.
3. A. P. Godse &D.A Godse, "Microprocessors and Microcontrollers", Technical Publications, 4th Edition, 2008.
4. A.Nagoor Kani, "Microprocessors and Microcontrollers",Tata McGraw-Hill publications, 2nd Edition, 2011.

Content Beyond Syllabus

- Verilog Hardware Description Language
- Interfacing of DMA and Timer circuits with Processor

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC302	DATA STRUCTURES	3	1	-

Course Pre-requisite

- Knowledge in C Programming language

Course Objectives

- To acquaint students with data structures used when programming for the storage and manipulation of data
- The concept of data abstraction and the problem of building implementations of abstract data types are emphasized
- To understand the applications of graph theory in various domains
- To develop skills to design and analyze simple linear and non linear data structures
- To identify and apply the suitable data structure for given real world problem

Course Outcomes

- Selection of relevant data structures and combinations of relevant data structures for the given problems in terms of memory and run time efficiency
- Apply data abstraction in solving programming problems
- Apply Graph theoretical approaches for solving real-life problems
- To identify and appropriate data structure for given problem
- To design and analyze time and space efficiency of data Structure

UNIT I – Introduction: Algorithmic notation – Programming principles – Creating programs- Analyzing programs. Arrays: One dimensional array, multidimensional array, pointer arrays. Searching: Linear search, Binary Search, Fibonacci search. Sorting techniques: Internal sorting - Insertion Sort, Selection Sort, Shell Sort, Bubble Sort, Quick Sort, Heap Sort, Merge Sort and Radix Sort.

UNIT II – Stacks: Definition – operations - applications of stack. Queues: Definition - operations - Priority queues – Dequeues – Applications of queue. Linked List: Singly Linked List, Doubly Linked List, Circular Linked List, linked stacks, Linked queues, Applications of Linked List – Dynamic storage management – Generalized list.

UNIT III – Trees: Binary tree, Terminology, Representation, Traversals, Applications – Binary search tree – AVL tree. B Trees: B Tree indexing, operations on a B Tree, Lower and upper bounds of a B Tree - B + Tree Indexing – Trie Tree Indexing.

UNIT IV – Graph: Terminology, Representation, Traversals – Applications - spanning trees, shortest path and Transitive closure, Topological sort. Sets: Representation - Operations on sets – Applications.

UNIT V – Tables: Rectangular tables - Jagged tables – Inverted tables - Symbol tables – Static tree tables - Dynamic tree tables - Hash tables. Files: queries - Sequential organization – Index techniques. External sorting: External storage devices – Sorting with tapes and disks.

TOTAL PERIODS: 60

Text Books

1. Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures”,Galgotia Book Source,Pvt. Ltd ,2004.
2. D. Samanta, “Classic Data Structures”, Second Edition, Prentice-Hall of India, Pvt. Ltd., India, 2012.

Reference Books

1. Robert Kruse, C.L. Tondo and Bruce Leung, “Data Structures and Program Design in C”, Prentice-Hall of India, Pvt. Ltd., Second edition, 2007.
2. MarkAllenWeiss, “Data Structures and Algorithm Analysis in C”, Pearson Education, Second edition, 2006.

Content Beyond Syllabus

- Red Black Tree
- Splay Tree

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC303	PYTHON PROGRAMMING	3	1	-

Course Pre-requisite

- Basics of Computer programming

Course Objectives

- To learn and understand python programming basics and paradigm
- The concept of data abstraction and the problem of building implementations of abstract data types are emphasized
- To acquaint students with data structures used when programming for the storage and manipulation of data
- To Understand List, Tuples and Dictionaries operations
- To learn and know the concept of file handling, Exception handling

Course Outcomes

- Under the basic concepts of Python Programming
- Develop algorithmic solutions to simple computational problems
- Structure simple Python programs for solving problems
- Represent compound data using Python lists, tuples, dictionaries
- Develop applications using file and exception handling concepts

UNIT I – Introduction: History , Features , Working with Python, Installing Python, basic syntax, interactive shell, editing, saving, and running a script. The concept of data types; variables, assignments; immutable variables; numerical types; Arithmetic and Logical operators and Boolean expressions. Debugging, comments in the program; understanding error messages; Catching exceptions using try and except.

UNIT II – Data, Expressions, Statements: Python interpreter andinteractive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III – Control Flow, Functions: Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, GCD, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV – Lists, Tuples, Dictionaries: Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

UNIT V – Files, Modules, And Packages: Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL PERIODS: 60

Text Books

1. Martin C. Brown, "The Complete reference – Python", Tata McGraw hill edition 2018.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Updated for Python 3, Shroff O'Reilly Publishers, 2016.
3. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python", Network Theory Ltd., 2011.

Reference Books

1. Budd T A, “Exploring Python”, Tata McGraw Hill Education 2011.
2. Mark Lutz, “Learning Python”, Fourth Edition, O’Re illy publication, June 2013.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach”, Pearson India Education Services Pvt. Ltd., 2016.

Content Beyond Syllabus

- Writing GUIs in Python
- Python SQL Database Access

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC304	PRINCIPLES OF ARTIFICIAL INTELLIGENCE	3	1	-

Course Pre-requisite

- Basic Programming Concepts

Course Objectives

- Understand the various characteristics of a problem solving agent
- Learn about the different strategies involved in problem solving
- Learn about solving problems with various constraints
- Apply A.I to various applications like expert systems etc.
- Understand the different models of learning

Course Outcomes

- Have basic knowledge representation, problem solving, and learning methods of artificial intelligence
- Provide the apt agent strategy to solve a given problem
- Represent a problem using first order and predicate logic
- Design applications like expert systems and chat-bot
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem

UNIT I – Introduction to Artificial Intelligence and Problem-Solving Agent: Problems of AI, AI technique, Tic – Tac – Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents. Defining the problem as state space search, production system, problem characteristics, and issues in the design of search programs.

UNIT II – Search Techniques: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best -first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search.

UNIT III – Constraint Satisfaction Problems and Game Theory: Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

UNIT IV – Knowledge & Reasoning: Statistical Reasoning: Probability and Bays' Theorem, Certainty Factors and Rule-Base Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic. AI for knowledge representation, rule-based knowledge representation, procedural and declarative knowledge, Logic programming, Forward and backward reasoning.

UNIT V – Introduction to Machine Learning: Exploring sub-discipline of AI: Machine Learning, Supervised learning, Unsupervised learning, Reinforcement learning, Classification problems, Regression problems, Clustering problems, Introduction to neural networks and deep learning.

TOTAL PERIODS: 60

Text Books

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2015.
2. Nils J. Nilsson, "Artificial Intelligence: A New Synthesis", 1st Edition, Morgan-Kaufmann, 1998.

Reference Books

1. Elaine Rich, Kevin Knight, & Shivashankar B Nair, "Artificial Intelligence", McGraw Hill, 3rd ed.,2017.
2. Patterson, "Introduction to Artificial Intelligence & Expert Systems", Pearson, 1st ed. 2015.
3. Saroj Kaushik, "Logic & Prolog Programming", New Age International, Ist edition, 2002.
4. Joseph C. Giarratano,Gary D. Riley, "Expert Systems: Principles and Programming", 4th Edition, 2007.

Content Beyond Syllabus

- Fuzzy logic

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI BS305	DISCRETE MATHEMATICS	3	1	-

Course Pre-requisite

- Basic knowledge and understanding of the concepts like elementary algebra and arithmetic

Course Objectives

- To extend student's Logical and Mathematical maturity and ability to deal with abstraction
- To study various enumeration methods using principle of counting
- To understand various algebraic structures
- To obtain knowledge of discrete structures involving graphs
- To obtain knowledge of discrete structures involving trees

Course Outcomes

- Knowledge of the concepts needed to test the logic of a program
- Understanding in identifying structures on many levels
- Aware of a class of functions which transform a finite set into another finite set which relates to input and output functions in computer science
- Understand counting principles
- Concepts and properties of algebraic structures such as groups, rings and fields

UNIT I – Mathematical Logic: Propositional calculus – propositions and connectives, syntax; Semantics – truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility – natural deduction system and axiom system; Soundness and completeness.

UNIT II – Combinatorics: Basic counting sum and product, balls and bins problems, generating functions, recurrence relations. Proof techniques, principle of mathematical induction, pigeonhole principle.

UNIT III – Structured Sets: Set, relation – Algebraic System: Groups, Semi groups, monoid, homomorphism, cosets, Ring and Field (definition), Relation, Equivalence relations, Poset, Lattices, Hasse diagram, Boolean algebra.

UNIT IV – Graph Theory: Introduction – Graph Terminologies – Types of Graphs – Sub Graph- Multi Graph – Regular Graph – Isomorphism –Isomorphic Graphs – Sub-graph – Euler graph – Hamiltonian Graph – Related problems.

UNIT – V Trees: Trees –Properties- Distance and Centres – Types – Rooted Tree—Tree Enumeration Labeled Tree – Unlabeled Tree –Spanning Tree – Fundamental Circuits- Cut Sets – Properties – Fundamental Circuit and Cut-set- Connectivity-Separability – Related problems.

TOTAL PERIODS: 60

Text Books

1. Rosen, K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.
2. C. L. Liu, "Elements of Discrete Mathematics", 2nd Edition, McGraw Hill, New Delhi, 2017.

Reference Books

1. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2. Lipschutz, S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
3. Koshy, T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.

Content Beyond Syllabus

- Apply suitable graph models and algorithms for solving applications.

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI HS306	PROFESSIONAL ETHICS & HUMAN VALUES	3	-	-

Course Pre-requisite

- Social responsibility and human ethics

Course Objectives

- To emphasize into awareness on Engineering Ethics and Human Values
- To understand social responsibility of an engineer
- To appreciate ethical dilemma while discharging duties in professional life
- To understand the rights and responsibilities as an engineer
- To learn the global responsibility

Course Outcomes

- Able to apply ethics in society
- Explore the ethical issues related to engineering
- Able to realize the responsibilities and rights in the society
- More responsible and apply in real time
- Promote self reflection and critical inquiry that foster critical thinking of one's value and values of others

UNIT I – Human Values: Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage – Empathy – self confidence – Discrimination- Character.

UNIT II – Engineering Ethics: Senses of Engineering Ethics - Variety of Moral Issued - Types of Inquiry - Moral Dilemmas - Moral Autonomy - Kohlberg's Theory - Gilligan's Theory - Consensus And Controversy – Models of Professional Roles - Theories about Right Action - Self-Interest –Professional Ideals and Virtues - Uses of Ethical Theories. Valuing Time – Co-Operation – Commitment.

UNIT III – Engineering As Social Experimentation: Engineering as Experimentation - Engineers as Responsible Experimenters - Codes of Ethics – Importance of Industrial Standards - A Balanced Outlook on Law – Anticorruption- Occupational Crime -The Challenger Case Study.

UNIT IV – Engineer's Rights And Responsibilitieson Safety: Collegiality and Loyalty- Respect for Authority – Collective Bargaining – Confidentiality- Conflict of Interest – Occupational Crime – Professional Rights – IPR- Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis and Reducing Risk - The Three Mile Island, Bhopal Gas Plant and Chernobyl as Case Studies.

UNIT V – Global Issues: Multinational Corporations - Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership - Sample Code of Conduct.

TOTAL PERIODS: 60

Text Books

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, 2005.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, —"Engineering Ethics – Concepts and Cases" Wadsworth Thompson Learning, 2000.
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India,2004.

Reference Books

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, Fourth edition, 2012.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, Fourth edition 2012.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 8th Edition, 2017.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford Press , 2000.
5. R. Subramanian, "Professional Ethics", Oxford University Press, Reprint, 2nd Edition, 2017.

Content Beyond Syllabus

- Corporate Social responsibility

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI CP301	DIGITAL CIRCUIT AND MICROPROCESSOR LAB	-	-	3

Course Pre-requisite

- Basic digital integrated circuits - AND/OR/NOT gates, latches, de multiplexer
- Basic structure of a processor - arithmetic registers, address registers, basic addressing modes
- Basic assembly language programming

Course Objectives

- To know the concepts of Combinational circuits
- To understand the concepts of flip-flops, registers and counters
- Design an embedded system, including both hardware and software
- Decide what level of sophistication the microprocessor needs to have and what additional devices are needed based on the features of the application
- Determine how to connect the microprocessor, memories, and extra devices into a working system

Course Outcomes

- Learn the basics of gates
- Construct basic combinational circuits and verify their functionalities
- Apply the design procedures to design basic sequential circuit
- Ability to handle logical operations using assembly language programming
- Ability to handle string instructions using assembly language programming

LIST OF EXPERIMENTS

DIGITAL CIRCUITS

1. Study of logic gates..
2. Design and implementation of adders and subtractors using logic gates.
3. Design and implementation of multiplexer and demultiplexer using logic gates and study of IC 74150 and IC 74154
4. Design and implementation of encoder and decoder using logic gates and study of IC 7445 and IC 4147
5. Implementation of SISO, SIPO, PISO and PIPO shift registers using flipflops

8085 MICROPROCESSOR

6. Study of 8085 Microprocessor Trainer Kit and GNUSim for 8085
7. 8-bit Arithmetic Operations (Addition, Subtraction, Multiplication and Division)
8. Block Operations (Exchange, Fill, Reverse, Delete)
9. Finding the largest and smallest element in array
10. Sorting and Searching

8086 MICROPROCESSOR

11. Experiments Using 8086 Microprocessor with EMU 8086
    (a)Arithmetic Operations
    (b)Sorting and Searching

TOTAL PERIODS: 45

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI CP302	DATA STRUCTURES LAB	-	-	3

Course Pre-requisite

- C Programming Language

Course Objectives

- Understand and remember algorithms and its analysis procedure
- Introduce the concept of data structures through ADT including List, Stack, Queues
- To design and implement various data structure algorithms
- To introduce various techniques for representation of the data in the real world
- To develop application using data structure algorithms

Course Outcomes

- Select appropriate data structures as applied to specified problem definition
- Implement operations like searching, insertion, and deletion, traversing mechanism etc. on various data structures
- Implement appropriate sorting/searching technique for given problem
- Design advance data structure using Non-Linear data structure
- Determine and analyze the complexity of given Algorithm

LIST OF EXPERIMENTS

1. Searching algorithms - sequential, binary and Fibonacci search algorithms on an ordered list. Compare the number of key comparisons made during the searches
2. Sorting algorithms :Insertion Sort, Selection Sort, Bubble Sort
3. Sorting algorithms: Shell Sort, Quick Sort, and Heap Sort.
4. Sorting algorithms: Merge Sort, and Radix Sort
5. Evaluation of arithmetic expression to postfix expression
6. Queue, circular queue, priority queue,
7. Singly Linked List, Doubly Linked List, Circular Linked List
8. Tree traversals
9. Graph traversals
10. Implementation of Dijkstra's algorithm

TOTAL PERIODS: 45

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI CP303	PYTHON PROGRAMMING LAB	-	-	3

Course Pre-requisite

- Computer Concepts and C Programming,
- Database Management Systems

Course Objectives

- To acquire programming skills in core Python
- To acquire Object Oriented Skills in Python
- To design and implement various data structure algorithms
- To develop the skill of designing Graphical user Interfaces in Python
- To develop the ability to write database applications in Python

Course Outcomes

- Gain knowledge on the basic principles of Python programming language
- Demonstrate the use of built in data structures list and dictionary
- Implement object oriented concepts
- Implement database and GUI application
- Design and implement a program to solve a real world problem

LIST OF EXPERIMENTS

1. Python program for finding GCD of two numbers.
2. Square root of a number by Newton‘s Method.
3. Find Exponentiation of a number.
4. Maximum from a list of numbers.
5. Write a program to implement Linear Search.
6. Write a program to implement Binary Search.
7. Write a program to implement Selection sort.
8. Implement Insertion sort.
9. Implement Merge sort.
10. Write a program to find First N prime numbers.

TOTAL PERIODS: 45

IV SEMESTER

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI EC401	**OPERATING SYSTEMS**	**3**	**1**	**-**

Course Pre-requisite

- Knowledge in Computer Programming
- Knowledge in Data Structures

Course Objectives

- Learn how Operating System is Important for Computer System, process synchronization, inter-process communication and their services
- To understand the Process management and scheduling algorithm
- To learn memory management, virtual memory management and its algorithms
- To know concepts of I/O systems
- To learn various operating systems like Linux, Windows etc.,

Course Outcomes

- To understand the basic concepts and functions of Operating Systems
- To known various threading models, process synchronization and deadlocks
- Analyze the performance of various CPU scheduling algorithms
- Discuss various memory management schemes
- To have knowledge about administrative tasks on Linux servers and distinguish iOS and Android OS

UNIT I – Operating Systems Overview: Introduction to operating systems – Computer system organization, architecture – Operating system structure, operations – Process, memory, storage management – Protection and security – Distributed systems – Computing Environments – Open- source operating systems – OS services – User operating-system interface – System calls – Types – System programs – OS structure – OS generation – System Boot – Process concept, scheduling – Operations on processes – Cooperating processes – Inter-process communication – Examples – Multithreading models – Thread Libraries – Threading issues – OS examples.

UNIT II – Process Management: Basic concepts – Scheduling criteria – Scheduling algorithms – Thread scheduling – Multiple processor scheduling – Operating system examples –Algorithm Evaluation– The critical section problem – Peterson's solution – Synchronization hardware – Semaphores – Classic problems of synchronization – Critical regions – Monitors – Synchronization examples – Deadlocks – System model – Deadlock characterization – Methods for handling deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock detection – Recovery from deadlock.

UNIT III – Storage Management: Memory Management – Swapping – Contiguous memory allocation – Paging – Segmentation – Example: The Intel Pentium - Virtual Memory: Background – Demand paging – Copy on write – Page replacement – Allocation of frames – Thrashing.

UNIT IV – I/O Systems: File concept – Access methods – Directory structure – File-system mounting – Protection – Directory implementation – Allocation methods – Free-space management – Disk scheduling– Disk management – Swap-space management – Protection.

UNIT V – Case Study: The Linux System – History – Design Principles – Kernel Modules – Process Management – Scheduling – Memory management – File systems – Input and Output – Inter-process Communication – Network Structure – Security – Windows 7 – History – Design Principles – System Components – Terminal Services and Fast User – File system – Networking.

TOTAL PERIODS: 60

Text Books

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts Essentials", John Wiley & Sons Inc., 9th Edition, 2018.

Reference Books

1. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Addison Wesley, 26th February 2007.
2. D M Dhamdhere, "Operating Systems: A Concept-based Approach", Second Edition, Tata McGraw-Hill Education, 2007.
3. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2011.

Content Beyond Syllabus

- Real-time operating system scheduling
- Memory Hierarchy

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC402	COMPUTER NETWORKS	3	1	-

Course Pre-requisite

- Fundamental knowledge in Computer Programming
- Basics of Computers

Course Objectives

- To understand components of computer networks, its protocols, modern technologies and their applications
- To analyzing channel characteristics, access mechanism and data link protocols to design a network
- To understand the network and IPV protocols
- Knowledge of network traffic conditions, transport protocols and QoS
- To learn the usage of application layer with security

Course Outcomes

- Recognize the technological trends of Computer Networking
- Analyze data link layer and its applications
- Evaluate network layer and the protocols used
- Analyze transport layer protocols and congestion control
- Program network communication services for client/server and other application layouts

UNIT I – Data Communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

UNIT II – Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA.

UNIT III – Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping –ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

UNIT IV – Transport Layer: Process to Process Communication, User Datagram Protocol(UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

UNIT V – Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

TOTAL PERIODS: 60

Text Books

1. Behrouz A. Forouzan McGraw-Hi, "Data Communication and Networking", 4th Edition 2008.
2. William Stallings, "Data and Computer Communication", 8th Edition, Pearson Prentice Hall.

Reference Books

1. Tanenbaum A.S. and David J. Wetherall "Computer Networks", 5th edition Prentice Hall, 2011.
2. Stallings, W., "Data and Computer Communications", 10th Edition, Prentice Hall Int. Ed., 2013.
3. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Pearson Education, Third edition, 2006.

Content Beyond Syllabus

- Wireless Sensor Networks and Case study for developing a website and hosting it on the web

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI EC403	DATABASE MANAGEMENT SYSTEMS	3	1	-

Course Pre-requisite

- Knowledge in Computer Programming

Course Objectives

- To design databases for an application domain
- To solve queries using Query languages
- To understand normalization , transactions and concurrency control
- To understand database authorization and recovery concepts
- To understand indexing and hashing concepts

Course Outcomes

- Classify modern and futuristic database applications based on size and complexity
- Design a database from an Universe of Discourse, using ER diagrams
- Map ER model into Relations and to normalize the relations
- Create a physical database from a design using DDL statements with appropriate key, domain and referential integrity constraints
- Analyze different ways of writing a query and justify which is the effective and efficient way

UNIT I – Database System Architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

UNIT II – Relational Query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS MYSQL, ORACLE, DB2, SQL server. Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

UNIT III – Storage Strategies: Indices, B-trees, hashing. Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

UNIT IV – Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

UNIT V –Advanced Topics: Object oriented and objects relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

TOTAL PERIODS: 60

Text Books

1. Avi Silberschatz, Henry F. Korth and S.Sudarshan, "Database System Concepts", McGraw-Hill, 7th edition 2017.

Reference Books

1. J. D. Ullman, "Principles of Database and Knowledge – Base Systems", Volume 1 Computer Science Press. 1st Edition, 1990.
2. R. Elmasri and S. Navathe, "Fundamentals of Database Systems", 6th Edition, 2005.
3. Abiteboul, Richard Hull, Victor Vianu, "Foundations of Databases", Reprint by Serge Addison-Wesley, 1990.

Content Beyond Syllabus

- Database used by google – Bigtable, NoSQL, NewSQL

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC404	ARTIFICIAL NEURAL NETWORKS	3	1	-

Course Pre-requisite

- Fundamentals of Artificial Intelligence

Course Objectives

- Understand the basics of ANN and comparison with Human brain
- Provide knowledge on Generalization and function approximation and various architectures of building an ANN
- Provide knowledge of reinforcement learning using neural networks
- Provide knowledge of unsupervised learning using neural networks
- To gain knowledge of Attractor neural networks

Course Outcomes

- Understand role of neural networks in engineering, artificial intelligence, and cognitive modeling
- Understand the concepts and techniques of neural networks through the study of the most important neural network models
- Evaluate whether neural networks are appropriate to a particular application
- Apply neural networks to particular applications
- To know what steps to take to improve performance

UNIT I – Introduction: Biological Neuron – Artificial Neural Model - Types of activation functions – Architecture: Feed forward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. XOR Problem, Multilayer Networks. **Learning:** Learning Algorithms, Error correction and Gradient Descent Rules, Learning objective of TLNs, Perceptron Learning Algorithm, Perceptron Convergence Theorem.

UNIT II – Supervised Learning: Perceptron learning and Non Separable sets, α-Least Mean Square Learning, MSE Error surface, Steepest Descent Search, μ-LMS approximate to gradient descent, Application of LMS to Noise Cancelling, Multi-layered Network Architecture, Back propagation Learning Algorithm, Practical consideration of BP algorithm.

UNIT III – Support Vector Machines and Radial Basis Function: Learning from Examples, Statistical Learning Theory, Support Vector Machines, SVM application to Image Classification, Radial Basis Function Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.

UNIT IV – Attractor Neural Networks: Associative Learning Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.

UNIT V – Self-organization Feature Map: Maximal Eigenvector Filtering, Extracting Principal Components Generalized Learning Laws, Vector Quantization Self-organization FeatureMaps, Application of SOM, Growing Neural Gas.

TOTAL PERIODS: 60

Text Books

1. Satish Kumar, “Neural Networks A Classroom Approach”, McGraw Hill Education (India) Pvt. Ltd, 2010.

Reference Books

1. J.M. Zurada, “Introduction to Artificial Neural Systems”, Jaico Publications 1994.
2. B. Yegnanarayana, “Artificial Neural Networks”, PHI, New Delhi 2004.

Content Beyond Syllabus

- Machine Learning and Deep Learning

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI HS405	ORGANIZATIONAL BEHAVIOUR	3	-	-

Course Pre-requisite

- Basic knowledge in organization and management

Course Objectives

- To develop cognizance of the importance of human behaviour
- To analyze specific strategic human resources demands for future action
- To creatively and innovatively encaging solving organizational challenges
- To understand organizational behaviour and management practices
- To increase understanding of the important issues pertaining to individual

Course Outcomes

- To analyze the inter personnel communication process to increase their effectiveness
- Evaluate the development of basic conflict resolutions
- Appraise their ability to manage, lead and work with other people in an organizational setting
- Examine what makes an organization, how organization evolve and what makes them effective
- Develop Ethical thinking

UNIT I – Focus And Purpose: Definition, need and importance of organizational behaviour – Nature and scope – Frame work – Organizational behaviour models.

UNIT II – Individual Behaviour: Personality – types – Factors influencing personality – Theories – Learning – Types of learners – The learning process – Learning theories – Organizational behaviour modification - Misbehaviour – Types – Management Intervention. Emotions - Emotional Labour – Emotional Intelligence – Theories. Attitudes – Characteristics – Components – Formation – Measurement- Values. Perceptions – Importance – Factors influencing perception – Interpersonal perception Impression Management Motivation – importance – Types – Effects on work behavior.

UNIT III – Group Behaviour: Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group decision making techniques – Team building - Interpersonal relations – Communication – Control.

UNIT IV – Leadership And Power: Meaning – Importance – Leadership styles – Theories – Leaders Vs Managers – Sources of power – Power centers – Power and Politics.

UNIT V – Dynamics Of Organizational Behaviour: Organizational culture and climate – Factors affecting organizational climate – Importance. Job satisfaction – Determinants – Measurements – Influence on behavior. Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change. Stress – Work Stressors – Prevention and Management of stress – Balancing work and Life. Organizational development – Characteristics – objectives

TOTAL PERIODS: 60

Text Books

1. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, “Essentials of Organizational Behaviour” Pearson, 2019.

Reference Books

1. K. Aswathappa, “Organizational Behavior”, Himalaya Publishing House, 2018.

Content Beyond Syllabus

- Human Psychology

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI CP401	**OPERATING SYSTEMS LAB**	**-**	**-**	**3**

Course Pre-requisite

- Programming Language
- Data Structures

Course Objectives

- Analyze the working of an operating system, its programming interface and file system
- To analyze Architecture of UNIX OS
- To provide necessary skills for developing and debugging program in UNIX environment
- Develop algorithms for process scheduling, memory management
- Understand page replacement algorithms and disk scheduling

Course Outcomes

- Exposure to different OS
- To gain knowledge in multiprogramming, multithreading and multitasking and memory management algorithms
- Demonstration of file-handling concepts by implementing suitable algorithms
- Awareness of computational issues, resources in distributed environment
- To demonstrate Disk Scheduling algorithm with real time concept

LIST OF EXPERIMENTS

1. Study of basic UNIX/Linux commands.
2. Shell Programming.
3. Programs using the following system calls of UNIX/Linux operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir.
4. Programs using the I/O system calls of UNIX operating system: (open, read, write, etc)
5. Simulations of UNIX/Linux commands like ls, grep, etc.
6. Simulation of processes scheduling algorithms.
7. Simulation of synchronization problems using Semaphore.
8. Simulation of basic memory management schemes.
9. Simulation of virtual memory management schemes.
10. Simulation of disk scheduling algorithms.

TOTAL PERIODS: 45

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI CP402	COMPUTER NETWORKS LAB	-	-	3

Course Pre-requisite

- Basics concepts of communication and computers
- Basics concepts of digital electronics

Course Objectives

- To understand the basic concepts of data communication, layered model
- To gain knowledge about protocols and interworking between computer networks and switching components in telecommunication systems
- Discuss the nature, uses and implications of internet technology
- To gain knowledge about remote command executions
- To develop an understanding of different components of computer networks

Course Outcomes

- Understand the basics of data communication, networking, internet and their importance
- Analyze the services and features of various protocol layers in data networks
- Differentiate wired and wireless computer networks
- Analyze TCP/IP and their protocols
- Recognize the different internet devices and their functions

LIST OF EXPERIMENTS

1. Implementation of a socket program for Echo/Ping/Talk commands
2. Creation of a socket between two computers and enable file transfer between them. Using
   (a.) TCP
   (b.) UDP
3. Implementation of a program for Remote Command Execution (Two M/Cs may be used)
4. Implementation of a program for CRC and Hamming code for error handling
5. Writing a code for simulating Sliding Window Protocols.
6. Create a socket for HTTP for web page upload & Download
7. Write a program for TCP module Implementation.(TCP services)
8. Write a program to implement RCP (Remote Capture Screen)
9. Implementation (using NS2/Glomosim) and Performance evaluation of the following routing protocols
   (a) Shortest path routing
   (b) Flooding
   (c) Link State
   (d) Hierarchical
10. Broadcast /Multicast routing
11. Implementation of ARP
12. Throughput comparison between 802.3 and 802.11

TOTAL PERIODS: 45

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI CP403	DATABASE MANAGEMENT SYSTEMS LAB	-	-	3

Course Pre-requisite

- Basics concepts of database and database management system
- Basics concepts of distributed systems

Course Objectives

- To explain basic database concepts, applications, data models, schemas and instances Discuss the nature, uses and implications of internet technology
- To demonstrate the use of constraints and relational algebra operations
- To emphasize the importance of normalization in databases
- To facilitate students in Database design
- To familiarize issues of concurrency control and transaction management

Course Outcomes

- Basic concepts of Database Systems and Application
- Use the basics of SQL and construct queries using SQL in database creation and interaction
- Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system
- Analyze and Select storage and recovery techniques of database system Recognize the different internet devices and their functions
- Develop solutions using database concepts for real time requirements

LIST OF EXPERIMENTS

1. Study of Database Concepts: Relational model – table – operations on tables – index – table space – clusters – synonym – view – schema – data dictionary – privilege – role transactions.

2. Study of SQL: Primitive Data Types – User Defined data Types – Built-in Functions – Parts of Speech of create, alter, drop, select, insert, delete, update, commit, rollback, save point, grant, revoke.

3. Study of Query Types: Queries involving Union, Intersection, Difference, Cartesian product, Divide Operations – Sub Queries – Join Queries – Nested Queries – Correlated, Queries – Recursive Queries.

4. Study of Procedural Query Language: Blocks, Exception Handling, Functions, Procedures, Cursors, Triggers, Packages.

5. Application: Design and develop any two of the following:
   (a)Library Information System
   (b)Logistics Management System
   (c) Students' Information System
   (d)Ticket Reservation System
   (e)Hotel Management System
   (f)Hospital Management System
   (g)Inventory Control
   (h) Retail Shop Management
   (i)Employee Information System
   (j) Payroll System

TOTALPERIODS: 45

V SEMESTER

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC501	**KNOWLEDGE REPRESENTATION AND REASONING**	**3**	**1**	**-**

Course Pre-requisite

- Exposure to AI and formal languages

Course Objectives

- To explore various representation and formalisms
- To gain knowledge about resolution
- To understand algorithms for reasoning, facts and rules
- To understand problem solving and representation of object and frames
- To understand various tool

Course Outcomes

- Explain various knowledge representations formalism in real world problem solving
- Describe knowledge engineering tools in problem solving
- Explain algorithms for reasoning
- Understand object oriented representation
- Implement a knowledge based system using various tools

UNIT I – Introduction: Key concepts – Need of knowledge representation and reasoning – Role of Logic – First order Logic – Syntax- Semantics- Pragmatics – Explicit and Implicit Belief – Expressing Knowledge.

UNIT II – Resolution: Propositional Case – Handling Variables and Quantifiers – Dealing with Computational Intractability – Reasoning with Horn Clauses –Horn Clauses- SLD Resolution – Computing SLD Derivations.

UNIT III – Reasoning: Procedural control of Reasoning – Facts and Rules – Rule formation and Search Strategy – Algorithm Design – Backtrack control – Negation as Failure – Rules in Production Systems.

UNIT IV – Representation: Object Oriented Representation – Object and Frames – Frame Formalism – Structured Descriptions – Description Language – Meaning and Entailment – Computing Entailments – Taxonomy and classification.

UNIT V – Languages and Tools: Working with LISP, Prolog – RDF Tools – Ontology tools.

TOTAL PERIODS: 60

Text Books

1. Ronald J.Brachman and H.J.Levesque, "Knowledge Representation and Reasoning", Elsevier, Morgan Kaufman publishers, 2004.

Reference Books

1. Deepak Khemani, "A First Course in Artificial Intelligence", , McGraw-Hill, First Edition 2013.
2. Stuart J Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Third Edition, PHI, 2009.

Content Beyond Syllabus

- Knowledge representation using Python

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC502	FUNDAMENTALS OF MACHINE LEARNING	3	1	-

Course Pre-requisite

- Knowledge in Programming languages (C,C++,python)

Course Objectives

- To introduce the fundamental concepts of machine learning and its applications
- To learn the classification, clustering and regression based machine learning algorithms
- To understand the deep learning architectures
- To understand the methods of solving real life problems using the machine learning techniques
- To understand the multiple learners, boosting and stacked generalization

Course Outcomes

- Understand the basic concepts of Bayesian theory and normal densities
- Implement different classification algorithms used in machine learning
- Implement clustering and component analysis techniques
- Design and implement deep learning architectures for solving real life problems
- Combine the evidence from two or more models/methods for designing a system

UNIT I – Bayesian Decision Theory and Normal Distribution: Machine perception - feature extraction - classification, clustering, linear and logistic regression – Types of learning - Bayesian decision theory - classifiers, discriminant functions, and decision surfaces -univariate and multivariate normal densities - Bayesian belief networks.

UNIT II – Classification Algorithms: Perceptron and backpropagation neural network - k-nearest-neighbor rule. Support vector machine: multicategory generalizations – Regression Decision trees: classification and regression tree – random forest.

UNIT III – Component Analysis and Clustering Algorithms: Principal component analysis - Linear discriminant analysis - Independent component analysis. K-means clustering - fuzzy k-means clustering – Expectation-maximization algorithm-Gaussian mixture models –auto associative neural network.

UNIT IV – Supervised and Unsupervised: Convolution neural network (CNN) -Layers in CNN - CNN architectures. Recurrent Neural Network -Applications: Speech-to-text conversion-image classification-time series prediction.

UNIT V – Combining Multiple Learners: Generating diverse learners - model combination schemes - voting - error-correcting output codes -bagging - boosting - mixture of experts revisited - stacked generalization - fine-tuning an ensemble –cascading

TOTAL PERIODS: 60

Text Books

1. R. O. Duda, E. Hart, and D.G. Stork, "Pattern Classification", Second Edition, John Wiley & Sons, Singapore, 2012.
2. Francois Chollet, "Deep Learning with Python", Manning Publications, Shelter Island, New York, 2018.

Reference Books

1. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, MIT Press, 2014.
2. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
4. Navin Kumar Manaswi, "Deep Learning with Applications using Python", A press, New York, 2018.

Content Beyond Syllabus

- Introduction to Genetic algorithm, Heuristic algorithms: A*, D*, Real-Time A*

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC503	PROBABILITY AND STATISTICS FOR ENGINEERS	3	1	-

Course Pre-requisite

- Basic knowledge in Mathematics

Course Objectives

- This course aims at providing the required skill to apply the statistical tools in engineering problems
- To introduce the basic concepts of probability and random variables
- To introduce the basic concepts of two dimensional random variables
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems
- To understand the basic concepts of statistical quality control

Course Outcomes

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications
- Apply the concept of testing of hypothesis for small and large samples in real life problems
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems

UNIT I – Probability And Random Variables: Probability – The axioms of probability –Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II – Two-Dimensional Random Variables: Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III – Testing Of Hypothesis: Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV – Design Of Experiments: One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial designs.

UNIT V – Statistical Quality Control: Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL PERIODS: 60

Text Books

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

Reference Books

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier,

2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

Content Beyond Syllabus

- Use of Bayes theorem, t -test for the research purposes
- Practicing hypothesis framing on real time applications

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC504	DATA VISUALIZATION	3	1	-

Course Pre-requisite

- Knowledge in Database Management System

Course Objectives

- To understand how accurately represent voluminous complex data set
- To understand the methodologies used to visualize large data sets
- To understand the concept of visualize data process
- To understand the process involved in data visualization
- To understand the security aspects involved in data visualization

Course Outcomes

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon
- Understand the basic concepts of one and two dimensional random variables
- Apply the concept of testing of hypothesis for small and large samples in real life problems
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems

UNIT I – Introduction: Context of data visualization – Definition, Methodology, Visualization Design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, and data visualization tools.

UNIT II – Visualizing Data Methods: Mapping - Time series Connections and correlations - Scatterplot maps - Trees, Hierarchies and Recursion - Networks and Graphs, Info graphics

UNIT III – Visualizing Data Process: Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder, Asynchronous Image Downloads, Advanced Web Techniques, Using a Database, Dealing with a Large Number of Files. Parsing data - Levels of Effort, Tools for Gathering Clues, Text Is Best, Text Markup Languages, Regular Expressions (regexps), Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.

UNIT IV – Interactive Data Visualization: Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts –Geomapping – Exporting, Framework – D3.js, and table.

UNIT V – Security Data Visualization: Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization -Intrusion detection log visualization -Attacking and defending visualization systems – Creating security visualization system.

TOTAL PERIODS: 60

Text Books

1. Scott Murray, "Interactive data visualization for the web", O"Reilly Media, Inc., 2nd edition, 2017.
2. Ben Fry, "Visualizing Data", O"Reilly Media, Inc., 2007.
3. Greg Conti, "Security Data Visualization: Graphical Techniques for Network Analysis", 1st Edition, 2007.

Reference Books

1. Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization Foundations, Techniques, Applications", 2010.
2. Robert Spence, "Information visualization – Design for interaction", Pearson Education, 2007.

Content Beyond Syllabus

- Image data visualization

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI HS505	INDUSTRIAL PSYCHOLOGY	3	1	-

Course Pre-requisite

- Understanding social psychology , physical and interpersonal characteristics of human beings

Course Objectives

- To understand the origins of Industrial Psychology and what Industrial Psychologists do
- To Increase awareness of important psychometric properties of personnel and psychological testing materials and their applications
- To Develop skills for designing and developing human/employee relationship with industry
- To impart relevant skills and knowledge for independent learning of other subjects that requires such skills and knowledge
- To understand the concepts of consumer psychology and Consumer decision making process

Course Outcomes

- Validate and develop a job specific selection design
- Understand how to design, develop, and evaluate job specific training program
- Develop reasoning for the usefulness of organizational psychology in the workplace
- Defend the utility of industrial/organizational psychology through research
- To be strong with decision making process

UNIT I – Introduction: Nature, Scope and Problems of Industrial Psychology, Historical Development. Psychology in Organizations, Scientific Management, Principles, Experiments Conducted for the Application of Principles, Critical Analysis of the Principles, Individual Differences and their Evaluation. Hawthorne studies and Implications.

UNIT II – Psychological Testing: Approaches, Validity, Advantages and Limitations in Industry. Attitude: Need, Importance, Measurement, Techniques used to improve Attitude in industry. Morale: Determinants, Measurement, Methods of improving morale. Job satisfaction: Meaning, Definition, Theories of job Satisfaction: Maslow's Hierarchy, Vroom's Theory, Herzberg's Theory, Stogdill's Theory, and Methods to improve Job Satisfaction.

UNIT III – Industrial Conflicts: Industrial Absenteeism; its Causes and Control. Labour Turnover: Relationship between Turnover and Job Complexity. Industrial Fatigue: Definition, Nature, Measurements, Production Curve, Mitigation Measures. Industrial Accident: Causes, Accident Proneness: Approaches, Critical Evaluation: Reduction and Prevention.

UNIT IV – Human Engineering: Importance, Development, Problems Stress and Mental Health of Employees: Causes, Reduction and Measures.

UNIT V – Consumer Psychology: Consumer Psychology Factors, Self-Image, Culture. Consumer Decision Making Process: Cognitive, Economic, Passive, Emotional Model.

TOTAL PERIODS: 60

Text Books

1. M.L. Blum & J.C. Naylor, "Industrial Psychology" (Its Theoretical & Social Foundations) CBS, 2004.
2. P.K. Ghosh & M.B. Ghorpade, "Industrial Psychology" Himalaya Publications, revised edition, 2016.
3. J.B. Miner, "Industrial-Organisation Psychology" Tata McGraw Hill, 2008.

Reference Books

1. Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization Foundations, Techniques, Applications", 2010.
2. Robert Spence "Information visualization – Design for interaction", Pearson Education, 2007.

Content Beyond Syllabus

- History of quantitative research in I/O Psychology

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI CP501	EXPERT SYSTEM LAB	-	-	3

Course Pre-requisite

- Programming Language

Course Objectives

- To study basics of PROLOG and LISP
- To demonstrate knowledge of issues and concerns and problem in computationally solving problem
- Apply analyze techniques to logic problem solving for propositional calculus
- To gain knowledge in symbolic manipulation language including LISP
- To gain knowledge in symbolic manipulation language including PROLOG

Course Outcomes

- Understand basic concepts of PROLOG
- Understand basic concepts of LISP
- To solve program using manipulation language
- Apply manipulation language concepts in real time applications
- To demonstrate active research areas and examples

LIST OF EXPERIMENTS

1. Study of PROLOG and LISP

Programs on LISP

2. Factorial using FOR statements
3. Write predicates to converts centigrade temperatures to Fahrenheit
4. Monkey Banana problem
5. 4-Queen problem
6. Traveling salesman problem

Programs on PROLOG

7. Find the factorial of a given number
8. Find the Fibonacci series
9. Solve traveling salesman problem
10. Sater jug problem
11. TICTACTOE game

TOTAL PERIODS: 45

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI CP502	MACHINE LEARNING LAB	-	-	3

Course Pre-requisite

- Basics concepts of linear algebra, probability and calculus.
- Basics programming skills

Course Objectives

- Make use of Data sets in implementing the machine learning algorithms
- Implement the machine learning concepts and algorithms in any suitable language of choice
- To introduce students to the basic concepts and techniques of Machine Learning
- To develop skills of using recent machine learning software for solving practical problems
- To gain experience of doing independent study and research

Course Outcomes

- Understand the mathematical and statistical prospective of machine learning algorithms through python programming
- Apply structured thinking to unstructured problems
- Design and evaluate the unsupervised models through python in built functions.
- Design and apply various reinforcement algorithms to solve real time complex problems.
- Develop an appreciation for what is involved in learning from data

LIST OF EXPERIMENTS

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample
4. Build an Artificial Neural Network by implementing the Back-propagation algorithm and test the same using appropriate data sets
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points.

TOTALPERIODS: 45

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI CP503	STATISTICS LAB	-	-	3

Course Pre-requisite

- Basics concepts of mean ,median, standard deviation and regression

Course Objectives

- To introduce the historical development of statistics, presentation of data, descriptive measures and fitting mathematical curves for the data
- To develop the ability to deal with numerical and quantitative issues in business
- To introduce measurement of the relationship of quantitative and qualitative data and the concept of probability
- To enable the use of statistical, graphical and algebraic techniques wherever relevant
- To have a proper understanding of Statistical applications.

Course Outcomes

- Infer the concept of correlation and regression for relating two or more related variables
- Demonstrate the probabilities for various events
- Critically evaluate the underlying assumptions of analysis tools
- Understand and critically discuss the issues surrounding sampling and significance
- Solve a range of problems using the techniques covered

LIST OF EXPERIMENTS

1. Operations on vectors and matrices
2. Creating and manipulating data frames.
3. Writing user defined functions for finding arithmetic mean, median, factorial, matrix addition and multiplication.
4. Bar and Pie charts.
5. Box plots for single and multiple groups.
6. Density and cumulative density plots for Binomial, Poisson, Normal and exponential distributions.
7. Checking Normality using Histogram and Q-Q plot.
8. Correlation coefficient – Pearson's, Spearman and Kendall's Tau.
9. Fitting simple linear and multiple linear regressions.
10. One sample and two sample t test.
11. One way and two ways ANOVA.

TOTALPERIODS: 45

V SEMESTER PROFESSIONAL ELECTIVES

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE501	**OBJECT ORIENTED PROGRAMMING**	**3**	**-**	**-**

Course Pre-requisite

- Basic knowledge on C programming

Course Objectives

- To understand the concepts of object oriented programming
- To expertise the programming skills through JAVA language
- To learn internet programming using object oriented approach
- To learn the concepts of generic programming and packages
- To understand the concepts of Java beans and RMI

Course Outcomes

- An ability to conceptualize the problem in terms of object oriented features
- An ability to use the OO programming techniques in real time applications
- An ability to design and develop a complete object oriented applications
- An ability to design and develop a Generic and package applications
- An ability to design and develop a complete object oriented applications using Java beans and RMI

UNIT I – Introduction: Java features: Java Platform –Java Fundamentals – Expressions, Operators, and Control Structures – Classes and Objects, Constructors – Destructors - Packages and Interfaces – Internationalization.

UNIT II – Overloading: Inheritance – Files and Stream – Multithreading – Exception Handling.

UNIT III – GUI Components: AWT package - Layouts –Containers - Event Package - Event Model –Painting –Garbage Collection – Java Applets – Applet Application - Swing Fundamentals - Swing Classes.

UNIT IV – Generics: Collections - Utility Packages –Input Output Packages - Inner Classes – Java Database Connectivity – Java security.

UNIT V – Java Beans: Application Builder Tools - Using the Bean Developer Kit -Jar Files- Introspection – BDK-Using BeanInfo Interface –Persistence-Java Beans API Using Bean Builder - Networking Basics - Java and the Net –InetAddress –TCP/IP Client Sockets – URL – URL Connection –TCP/IP Server - Sockets - A Caching Proxy HTTP Server – Datagrams – RMI.

TOTAL PERIODS: 60

Text Books

1. Deitel and Deitel, "JAVA How to Program", Prentice Hall, 2006.
2. Hari Mohan Pandey, "JAVA Programming", Pearson, 2012.

Reference Books

1. Herbert Schildt, Dale Skrien, "Java Fundamentals – A Comprehensive Introduction", Tata Mc Graw Hill, 2013.
2. John Dean, Raymond Dean, "Introduction to Programming with JAVA –A Problem Solving Approach", Tata Mc Graw Hill, 2012.
3. Ralph Bravaco, Shai Simonson, "Java Programming: From the Ground Up", Tata McGraw Hill 2nd Edition, 2012.

Content Beyond Syllabus

- Selenium Web Driver using Java

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE502	WEB TECHNOLOGY	3	-	-

Course Pre-requisite

- Knowledge in Computer Programming
- Knowledge in JAVA programming

Course Objectives

- To learn and program features of web programming languages
- To understand the basics of Web Designing using HTML, DHTML, and CSS
- To learn the basics about Client side scripts and Server side scripts
- Able to develop web application using Java Technologies
- To gain skills and project based experience needed for entry into web applications

Course Outcomes

- Understand major components and protocols of internet application
- Ability to design and develop client side scripting techniques
- Ability to build real world applications using client and server side scripting languages
- Able to develop Applications using PHP
- Design and develop web applications with database connectivity

UNIT I – Internet Principles and Components: History of the Internet and World Wide Web- – HTML - protocols – HTTP, SMTP, POP3, MIME, and IMAP. Domain Name Server, Web Browsers and Web Servers. HTML-Style Sheets-CSS-Introduction to Cascading Style Sheets-Rule-Features- Selectors- Attributes. Client-Side Programming: The JavaScript Language- JavaScript in Perspective-Syntax-Variables and Data Types-Statements-Operators.

UNIT II – Server Side Programming: Servlet- strengths-Architecture-Life cycle- Generic and HTTP servlet- Passing parameters- Server Side Include- Cookies- Filters. JSP- Engines- Syntax- Components- Scriplets- JSP Objects-Actions-Tag Extensions- Session Tracking- J2EE - Introduction - Beans- EJB.

UNIT IV – PHP: Basics, String Processing and Regular Expressions, Form Processing and Business Logic, Using Cookies, Dynamic Content, and Operator Precedence Chart.

UNIT V – Database Connectivity: DB with MySQL - Servlets, JSP, PHP. Case Studies- Student information system, Health Management System.

UNIT III – XML: Introduction- Revolutions of XML-XML Basics – Defining XML Documents: DTD-XML Schema-Namespaces – XFiles: XLink – XPointer - XPath - XML with XSL – XSL-FO-Parsing XML using DOM-SAX-Formatting XML on the web.

TOTAL PERIODS: 60

Text Books

1. Deitel and Deitel, Goldberg, “Internet and World Wide Web – How to Program”, Pearson Education Asia, Fifth Editon - 2012.
2. Jeffery Jackson “Web Technologies – A computer science Perspective”, Pearson Education - Second Edition – 2008.
3. UttamK.Roy, “Web Technologies”, Oxford University Press, First Edition -2012.

Reference Books

1. Rajkamal, “Web Technology”, Tata McGraw-Hill, First Edition - 2001.

Content Beyond Syllabus

- HTML5 and Hybrid App Development

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE503	DATA ANALYTICS	3	-	-

Course Pre-requisite

- Fundamental knowledge in DBMS

Course Objectives

- Be exposed to big data
- Learn the different ways of Data Analysis
- Be familiar with data streams
- Learn the mining and clustering
- Be familiar with the visualization

Course Outcomes

- Understand and apply the statistical analysis methods
- Compare and contrast various soft computing frameworks
- Design and develop distributed file systems
- To develop Stream data model
- Apply Visualization techniques in real time applications

UNIT I – Introduction To Big Data: Introduction to Big Data Platform – Challenges of conventional systems - Web data –Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting - Modern data analytic tools, Stastical concepts: Sampling distributions, resampling, statistical inference, prediction error.

UNIT II – Data Analysis: Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics - Rule induction - Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.

UNIT III – Mining Data Streams: Introduction to Streams Concepts – Stream data model and architecture - Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window –Real time Analytics Platform(RTAP) applications - case studies - real time sentiment analysis, stock market predictions.

UNIT IV – Frequent Itemsets and Clustering: Mining Frequent item sets - Market based model – A priori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent item sets in a stream –Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data –CLIQUE and PROCLUS – Frequent pattern based clustering methods – Clustering in non- euclidean space – Clustering for streams and Parallelism.

UNIT V – Frameworks and Visualization: MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 – Hadoop Distributed file systems – Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications.

TOTAL PERIODS: 60

Text Books

1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.
2. Anand RajaRaman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.

Reference Books

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with

advanced analystics", John Wiley & sons, 2012.
2. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O' Reilly, 2011.
3. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.

Content Beyond Syllabus

- Predictive Analytics, linear regression

VI SEMESTER

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC601	**DEEP LEARNING TECHNIQUES**	**3**	**1**	**-**

Course Pre-requisite

- Knowledge in Artificial Neural networks

Course Objectives

- To present the mathematical, statistical and computational challenges of building neural networks
- To study the concepts of deep learning
- To introduce dimensionality reduction techniques
- To enable the students to know deep learning techniques to support real-time applications
- To under the concept imagenet

Course Outcomes

- Understand basics of deep learning
- Implement various deep learning models
- Realign high dimensional data using reduction techniques
- Analyze optimization and generalization in deep learning
- Explore the deep learning applications

UNIT I – Introduction to Machine Learning: Linear models (SVMs and Perceptions, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates.

UNIT II – History of Deep Learning: A Probabilistic Theory of Deep Learning- Back propagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks- Convolutional Networks- Generative Adversarial Networks (GAN), Semi- supervised Learning.

UNIT III – Linear (PCA, LDA) and Manifolds: metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convent - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convent: weights initialization, batch normalization, hyper parameter optimization.

UNIT IV – Optimization in Deep Learning: Non-convex optimization for deep networks- Stochastic Optimization- Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience.

Unit V – Applications of Deep Learning: Images segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative adversarial networks – Video to Text with LSTM models – Attention models for Computer Vision – Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.

TOTAL PERIODS: 60

Text Books

1. CosmaRohillaShalizi, "Advanced Data Analysis from an Elementary Point of View", 2015.
2. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
3. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
4. Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015.

Reference Books

1. Jon Krohn, Beyleveld Grant and Bassens Aglaé, " Deep Learning Illustrated: A Visual, Interactive", Guide to Artificial Intelligence, Addison-wesley, 2019.
2. Hyatt Saleh, "Applied Deep Learning with PyTorch", Packt, 2019.
3. Pradeep Pujari, Md. And Rezaul Karim, Mohit Sewak, "Practical Convolutional Neural Networks", Packt Publishing, February 2018.
4. Ragav Venkatesan and Baoxin Li, "Convolutional Neural Networks in Visual Computing (Data Enabled Engineering)", CRC Press, September 2017.

Content Beyond Syllabus

- Case study for developing a applications on Image analysis

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC602	DATA SCIENCE	3	1	-

Course Pre-requisite

- Knowledge in Computer Programming
- Basics of Computers

Course Objectives

- Will gain knowledge in the basic concepts of Data Analysis
- To acquire skills in data preparatory and preprocessing steps
- To learn the tools and packages in Python for data science
- To gain understanding in classification and Regression Model
- To acquire knowledge in data interpretation and visualization techniques

Course Outcomes

- Apply the skills of data inspecting and cleansing
- Determine the relationship between data dependencies using statistics
- Can handle data using primary tools used for data science in Python
- Can apply the knowledge for data describing and visualization using tools
- To apply the knowledge in matplotlib

UNIT I – Introduction: Need for data science – benefits and uses – facets of data – data science process – setting their search goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT II – Describing Data I: Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs –averages – mode – median – mean – averages for qualitative and ranked data – describing variability – range – variance – standard deviation – degrees of freedom – inter quartile range –variability for qualitative and ranked data.

UNIT III – Python For Data Handling: Basics of Numpy arrays – aggregations – computations on arrays – comparisons, masks, Boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – hierarchical indexing – combining datasets –aggregation and grouping – pivot tables.

UNIT IV – Describing Data II: Normal distributions – z scores – normal curve problems– finding proportions – finding scores –more about z scores – correlation – scatter plots – correlation coefficient for quantitative data –computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2– multiple regression equations –regression toward the mean.

UNIT V – Python For Data Visualization: Visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings, and density – three dimensional plotting – geographic data – data analysis using state models and seaborn – graph plotting using Plotly – interactive data visualization using Bokeh.

TOTAL PERIODS: 60

Text Books

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (first two chapters for Unit I)
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Chapters 1–7 for Units II and III)
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Chapters 2– 4 for Units IV and V)

Reference Books

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.

Content Beyond Syllabus

- Wireless Sensor Networks
- Case study for developing a website and hosting it on the web

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI CP601	DEEP LEARNING LAB	-	-	3

Course Pre-requisite

- Basics concepts of Machine learning
- Basics programming skills

Course Objectives

- To understand the theoretical foundations, algorithms and methodologies of Neural Network
- To design and develop an application using specific deep learning models
- To provide the practical knowledge in handling and analysing real world applications
- Gaining practical experience in programming tools for deep learning
- Empowering students with tools and techniques used in deep learning

Course Outcomes

- Recognize the characteristics of deep learning models that are useful to solve real-world problems
- Understand different methodologies to create application using deep nets
- Identify and apply appropriate deep learning algorithms for analyzing the data for variety of problems
- Implement different deep learning algorithms
- Design the test procedures to assess the efficacy of the developed model

LIST OF EXPERIMENTS

1. Solving XOR problem using Multilayer perceptron.
2. Implement character and Digit Recognition using ANN.
3. Implement the analysis of X-ray image using auto encoders.
4. Implement Speech Recognition using NLP.
5. Develop a code to design object detection and classification for traffic analysis using CNN.
6. Implement online fraud detection of share market data using any one of the data analytics tools.
7. Implement image augmentation using deep RBM.
8. Implement Sentiment Analysis using LSTM.
9. Mini Project: Number plate recognition of traffic video analysis.

TOTALPERIODS: 45

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI CP602	DATA SCIENCE LAB	-	-	3

Course Pre-requisite

- Basics concepts of Machine learning
- Basics programming skills

Course Objectives

- Building the fundamentals of data science
- Imparting design thinking capability to build big-data
- Developing design skills of models for big data problems
- Gaining practical experience in programming tools for data sciences
- Empowering students with tools and techniques used in data science

Course Outcomes

- Apply data visualization in big-data analytics
- Utilize EDA, inference and regression techniques
- Utilize Matrix decomposition techniques to perform data analysis
- Apply data pre-processing techniques
- Apply Basic Machine Learning Algorithms

LIST OF EXPERIMENTS

1. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves).
2. Map Reduce application for word counting on Hadoop cluster.
3. Unstructured data into NoSQL data and do all operations such as No SQL query with API.
4. K-means clustering using map reduce.
5. PageRank Computation.
6. Mahout machine learning library to facilitate the knowledge build up in bigdata analysis.
7. Application of Recommendation Systems using Hadoop/mahout libraries.

TOTALPERIODS: 45

VI SEMESTER PROFESSIONAL ELECTIVES

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE601	**DESIGN OF MODERN HEURISTICS**	**3**	**-**	**-**

Course Pre-requisite

- Knowledge of fundamental concepts of Designing Strategies

Course Objectives

- To enable the students to understand the optimization methods
- To design application of optimization techniques
- To practice the optimization techniques using search strategies
- To learn heuristics algorithms
- To learn real time case study

Course Outcomes

- Identify the importance of optimization methods
- Design optimization techniques for real world problems
- List the results obtained through optimization
- Describe heuristics algorithms
- To gain knowledge and implement case study problems

UNIT I – Optimization Problems: Introduction - Solution Process – Recognizing Problems, Defining Problems, Constructing Models, Solving Models Validating Solutions, Implementing Solutions-Problem Instances-Search Spaces - Metrics, Neighborhoods, Fitness Landscapes, Optimal Solutions - Properties of Optimization Problems - Problem Difficulty, Locality, Decomposability.

UNIT II – Optimization Methods: Analytical and Numerical Optimization Methods- Optimization Methods for Linear, Continuous Problems - Linear Optimization Problems, Simplex Method Optimization Methods for Linear, Discrete Problems.

UNIT III – Heuristics: Introduction-Heuristics – Applications- Heuristic Optimization Methods - Heuristics, Approximation Algorithms, Modern Heuristics.

UNIT IV – Search Strategies: Local Search Methods-Recombination-Based Search-Genetic Algorithms, Estimation of Distribution Algorithms, Genetic Programming.

UNIT V – Case Study: The Optimal Communication Spanning Tree Problem – Biasing Modern Heuristics for OCST Problems - Search Operator - Representation – Initialization - Using an MST as Initial Solution.

TOTAL PERIODS: 60

Text Books

1. Rothlauf, Franz, "Design of Modern Heuristics - Principles and Application", Nature Computing Series, Springer 2011.

Reference Books

1. Xiaopeng Fang, "Engineering Design Using Genetic Algorithms", Iowa State University 2007.
2. David E. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine learning", Addison -Wesley publishing company, Inc., 1st Edition, 1989.

Content Beyond Syllabus

- Advanced optimization methods

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE602	EVOLUTIONARY COMPUTATION	3	-	-

Course Pre-requisite

- Basic knowledge in programming competence

Course Objectives

- To master the basics of EA
- To learn the techniques for solving optimization problems through EA
- To learn genetic programming
- To learn multi objective optimization
- To gain knowledge about advance operators and techniques in genetic algorithm

Course Outcomes

- Design evolutionary techniques real problem by choosing the parameters for optimal performance
- Evaluate the job shop scheduling and routing problems using genetic algorithms
- Implement genetic programming and solve classic GP problems
- Understand multi objective optimization
- Understand Advance operators and techniques in Genetic Algorithm

UNIT I – Introduction to EA: EA Basics: Introduction to Evolutionary Computation: Biological evolution and genetics- artificial evolution, Basics of optimization and search space , evolutionary computation and AI, lasses of EA- Structure of EA - Advantages of Evolutionary Computation -.Hybridization with Other Methods - Parallelism - Applications of Evolutionary Computation.

UNIT II – Genetic Algorithm: A simple genetic algorithm- Biological background – Encoding Fitness Evaluation techniques - Search Operators: Crossover, mutation- Selection Schemes: Fitness proportional selection and fitness scaling, ranking, tournament selection, Selection pressure and its impact on evolutionary search. The Schema Theorem in GA- Building Block Hypothesis - Applications of GA in Engineering problems, job shop scheduling and routing problems.

UNIT III – Advanced operators and techniques in Genetic Algorithm: Inversion and reordering operators – Micro operators- Population sizing - Advanced selection schemes- Types of GA Parallel & Distributed GA- Hybrid GA- Adaptive GA – Genetic algorithm implementation using MATLAB.

UNIT IV – Genetic Programming: Genetic programming and how it differs from GA., The creation and regeneration of populations: crossover, mating, and reproduction Classic GP problems and their solutions

UNIT V – Multi-objective Optimization: Linear and nonlinear multi-objective problems, convex and non – convex problems, dominance – concepts and properties, Pareto – optimality, Use of Evolutionary Computations to solve multi objective optimization. NSGA, SPEA, etc. for multi-objective optimization.

TOTAL PERIODS: 60

Text Books

1. Sivanandam, S.N., Deepa, S. N ,"Introduction to Genetic Algorithms", Springer, 2011.
2. Deb, K.: "Multi-Objective Optimization using Evolutionary Algorithms", John Wiley and Son, 2002.
3. John Koza, "Genetic Programming", MIT Press, 2005.

Reference Books

1. D. E. Goldberg, Genetic Algorithm In Search, Optimization And Machine Learning, New York: Addison _ Wesley (1989).

Content Beyond Syllabus

- Swarm Intelligence
- Advanced mean field methods

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE603	COMPUTATIONAL INTELLIGENCE	3	-	-

Course Pre-requisite

- Strong knowledge of Mathematics and AI
- Good command over programming languages

Course Objectives

- To understand the fundamentals of key intelligent systems technologies
- To understand hybrid intelligent systems
- To understand evolutionary computation
- To practice in an integration of intelligent systems technologies for engineering applications
- To understand case studies problems

Course Outcomes

- Explain the fundamentals of key intelligent systems technologies
- Describe neural networks, fuzzy systems, and evolutionary computation
- Explain the hybrid intelligent systems
- List the integration of intelligent systems technologies for engineering applications
- To implement computational intelligence concepts in case studies

UNIT I – Introduction: Computational Intelligence: Intelligence machines - Computational intelligence paradigms –History- Expert Systems: Rule-based expert systems –Uncertainty management - Fuzzy expert systems: Fuzzy sets and operations sets - Fuzzy rules and inference - Fuzzy expert systems.

UNIT II – Artificial Neural Networks: Fundamental neuro computing concepts: artificial neurons, activation functions, neural network architectures, learning rules - Supervised learning neural networks: multi-layer feed forward neural networks, simple recurrent neural networks, time-delay neural networks, supervised learning algorithms - Unsupervised learning neural networks: self-organizing feature maps - Radial basis function networks -Deep neural networks and learning algorithms.

UNIT III – Evolutionary computation: Representation: Chromosomes-fitness functions- selection mechanisms -Genetic algorithms: crossover and mutation - Genetic programming.

UNIT IV – Hybrid Intelligent Systems: Neural expert systems -Neuro-fuzzy systems – Evolutionary neural networks.

UNIT V – Applications and Case Studies: Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction-Case studies.

TOTAL PERIODS: 60

Text Books

1. A.P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition, John Wiley & Sons, 2012.

Reference Books

1. S.Rajasekaran and G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy logic and Genetic Algorithms-Synthesis and Applications", PHI Learning, 2003.
2. Marsland S, "Machine Learning: An Algorithmic Perspective", CRC Press, 2009.
3. Russell and P. Norvig, "Artificial Intelligence – A Modern Approach", Prentice Hall, 2010.
4. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education , 2004.

Content Beyond Syllabus

- Application of intelligence on solving NP problems, Swarm Intelligence

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE604	SOFTWARE ENGINEERING	3	-	-

Course Pre-requisite

- Knowledge in Computer programming

Course Objectives

- Identify, formulate, and solve software engineering problems
- Elicit, analyze and specify software requirements through a productive working
- Understanding professional, ethical and social responsibility of a software engineer
- Participate in design, development, deployment and maintenance of a medium scale software development project
- To understand user interface and testing

Course Outcomes

- Ability to apply basic knowledge and understanding of the analysis, synthesis and design of complex systems
- Develop, maintain and evaluate large-scale software systems
- Produce efficient, reliable, robust and cost-effective software solutions
- Able to develop Software testing tool
- Evaluate project by using project management and requirements analysis

UNIT I – Introduction to Software Engineering: The Software Engineering Discipline – Evolution and Impact – Software Development projects – Emergence of Software Engineering – Computer System Engineering – Software Life Cycle Models – classic Waterfall model – Iterative Lifecycle model – prototyping model – Evolutionary model spiral model – Comparison of Life cycle models.

UNIT II – Software Project Management and Requirements Analysis: Responsibilities of a Software Project Manager – Project Planning – Metrics for Project Size Estimation – Empirical Estimation Techniques – COCOMO Halstead's Software Science – Staffing Level Estimation – Scheduling – Organization and Team structures – Staffing Risk Management – Software Configuration Management – Requirements Gathering and Analysis – Software Requirements specification – Formal System Specification –Axiomatic Specification - Algebraic Specification – 4GL.

UNIT III – Software Design and Function Oriented Software Design: Outcome of a Design Process – Characteristics of a Good Software Design – Coupling and Cohesion – Approaches to Software Design – Object Oriented Vs Function Oriented Software Design approaches – Structured Analysis – Data Flow Diagrams – Applying DFD to Real time systems – Structured and Detailed Design.

UNIT IV – Object Modeling and Object Oriented Software development: Overview of OO concepts – UML – Use case model – Class diagrams – Interaction diagrams – Activitydiagrams – state chart diagrams - Patterns – Types – Object Oriented Analysis and Design methodology – Interaction Modeling – OOD Goodness criteria.

UNIT V – User Interface Design and Testing: Characteristics of a good User Interface – Types – Fundamentals of Component based GUI Development – A User Interface Design methodology – Coding – Software Documentation – Testing – Unit Testing – Black Box testing – White Box testing – Debugging – Program Analysis tools – Integration testing – Testing Object Oriented programs – System Testing – Issues.

TOTAL PERIODS: 60

Text Books

1. Rajib Mall, "Fundamentals of Software Engineering", PHI Learning, Third Edition, 2013.

Reference Books

1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw-Hill International Edition, Seventh Edition, 2009.

2. S. L. P fleeger and J.M. Atlee, “Software Engineering Theory and Practice”, Pearson Education, Third Edition, 2008.
3. Pankaj Jalote, “An Integrated Approach to Software Engineering”, Narosa, Third Edition, 2008.
4. Ian Sommerville, “Software Engineering”, Pearson Education, Eighth Edition, 2008.

Content Beyond Syllabus

- Agile and RAD SDLC Models

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE605	COGNITIVE SCIENCE	3	-	-

Course Pre-requisite

- Basic computer knowledge
- Basic electronics knowledge

Course Objectives

- To learn the basics of Cognitive Science with focus on acquisition
- To representation, and use of knowledge by individual minds, brains, and machines
- To study the mind and intelligence, embracing psychology, artificial intelligence, neuroscience and linguistics
- To understand the role of neuro science in the cognitive field
- To gain knowledge about tools

Course Outcomes

- List Cognitive Science with focus on acquisition
- Describe the representation, and use of knowledge by individual minds, brains, and machines
- Perform neuroscience and linguistics based experiments
- Implement the knowledge of neuro science in the cognitive field
- Evaluate real world problem with this tool

UNIT I – Introduction to Cognitive Science: The Cognitive view –Some Fundamental Concepts – Computers in Cognitive Science – Applied Cognitive Science – The Interdisciplinary Nature of Cognitive Science.

UNIT II – Cognitive Psychology: Cognitive Psychology – The Architecture of the Mind The Nature of Cognitive Psychology- A Global View of The Cognitive Architecture- Propositional Representation- Schematic Representation- Cognitive Processes, Working Memory, and Attention- The Acquisition of Skill- The Connectionist Approach to Cognitive Architecture.

UNIT III – Language Acquisition, Semantics and Processing Model: Milestones in Acquisition – Theoretical Perspectives- Semantics and Cognitive Science – Meaning and Entailment –Reference – Sense – Cognitive and Computational Models of Semantic Processing –Information Processing Models of the Mind- Physical symbol systems and language of thought- Applying the Symbolic Paradigm- Neural networks and distributed information processing- Neural network models of Cognitive Processes.

UNIT IV – Integration Challenge: Cognitive Science and Integration Challenge – Tackling the Integration Challenge.

UNIT V – Tools: Working with Concept Maps – Scribe Note making tools.

TOTAL PERIODS: 60

Text Books

1. Jose Luis Bermudez, “Cognitive Science: An Introduction to the Science of the Mind”, Cambridge University Press, New York, 2014.

Reference Books

1. Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, “Cognitive Science: An Introduction”, Second Edition, MIT press, 1995.

Content Beyond Syllabus

- Cognitive radio technology

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE606	OPTIMIZATION TECHNIQUES	3	-	-

Course Pre-requisite

- Ability to program in some language
- Prior exposure to fields such as machine learning, signal processing, operations research

Course Objectives

- To introduce the basic concepts of linear programming
- To educate on the advancements in Linear programming techniques
- To introduce non-linear programming techniques
- To introduce the interior point methods of solving problems
- To introduce the dynamic programming method

Course Outcomes

- Understand the concepts of linear programming
- Apply Linear programming techniques
- Apply non-linear programming techniques
- To solve problems using interior point methods
- Understand the dynamic programming

UNIT I – Linear Programming: Introduction - formulation of linear programming model-Graphical solution–solving LPP using simplex algorithm – Revised Simplex Method.

UNIT II – Advances In LPP: Duality theory- Dual simplex method - Sensitivity analysis--Transportation problems– Assignment problems-Traveling sales man problem - Data Envelopment Analysis.

UNIT III – Non Linear Programming: Classification of Non Linear programming – Lagrange multiplier method – Karush – Kuhn Tucker conditions–Reduced gradient algorithms–Quadratic programming method – Penalty and Barrier method.

UNIT IV – Interior Point Methods: Karmarkar's algorithm–Projection Scaling method–Dual affine algorithm–Primal affine algorithm Barrier algorithm.

UNIT V – Dynamic Programming: Formulation of Multi stage decision problem– Characteristics– Concept of sub- optimization and the principle of optimality–Formulation of Dynamic programming– Backward and Forward recursion– Computational procedure– Conversion of final value problem in to Initial value problem.

TOTAL PERIODS: 60

Text Books

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2000.
2. R. Panneerselvam, "Operations Research", PHI, 2006.
3. Hamdy ATaha, "Operations Research –An Introduction", Prentice Hall India, 2003

Reference Books

1. Philips, Ravindran and Solberg, "Operations Research", John Wiley, 2002.
2. Rardin, "Optimization in Operation Research" Pearson Education Pvt. Ltd. New Delhi, 2005.

Content Beyond Syllabus

- Its influences on research problems

VII SEMESTER

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PC701	**THEORY OF COMPUTATION**	**3**	**1**	**-**

Course Pre-requisite

- Basic knowledge in programming
- Basics of Computational formation

Course Objectives

- To understand the language hierarchy
- To construct automata for any given pattern and find its equivalent regular expressions
- To design a context free grammar for any given language
- To understand Turing machines and their capability
- To understand undecidable problems and NP class problems

Course Outcomes

- Construct automata, regular expression for any pattern
- Write Context free grammar for any construct
- Design Turing machines for any language
- Propose computation solutions using Turing machines
- Derive whether a problem is decidable or not

UNIT I – Automata Fundamentals: Introduction to formal proof – Additional forms of Proof – Inductive Proofs –Finite Automata – Deterministic Finite Automata – Non- deterministic Finite Automata – Finite Automata with Epsilon Transitions.

UNIT II – Regular Expressions And Languages: Regular Expressions – FA and Regular Expressions - Proving Languages not to be regular – Closure Properties of Regular Languages – Equivalence and Minimization of Automata.

UNIT III – Context Free Grammar And Languages: CFG – Parse Trees – Ambiguity in Grammars and Languages – Definition of the Pushdown Automata – Languages of Pushdown Automata – Equivalence of Pushdown Automata and CFG, Deterministic Pushdown Automata.

UNIT IV – Properties Of Context Free Languages: Normal Forms for CFG – Pumping Lemma for CFL - Closure Properties of CFL – Turing Machines – Programming Techniques for TM.

UNIT V – Undecidability: Non Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM – Post's Correspondence Problem, The Class P and NP.

TOTAL PERIODS: 60

Text Books

1. J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education, 2003.

Reference Books

1. H.R.Lewis and C.H.Papadimitriou, —Elements of the theory of Computation, Second Edition, PHI, 2003.
2. J.Martin, —Introduction to Languages and the Theory of Computation, Third Edition,TMH, 2003.
3. Micheal Sipser, —Introduction of the Theory and Computation, Thomson Brokecole,1997.

Content Beyond Syllabus

- Theory of Computation for Application Development
- Apps will be built Based on Computational Algorithms

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI BS705	BIOLOGY FOR ENGINEERS	3	-	-

Course Pre-requisite

- Basics of Biology

Course Objectives

- Introduction to Basics of Biology which includes cell, Different types of cells and classification of living organisms
- Understanding what are biomolecules present in a cell, their structure function
- Application of certain bio molecules in Industry
- Brief introduction to human physiology, which is essential for bioengineering field
- How biology can be applied in our daily life using different technology

Course Outcomes

- Define the cells, its structure and function, Different types of cells and basis for Classification of living organisms
- Explain about bio molecules its structure and function and their role in a living organism
- Bio molecules are useful in Industry & explain about human physiology
- Evaluate Concept of species and strains
- Demonstrate the concept of biology and its uses in combination with different technologies

UNIT I – Classification: Classification outline based on (a) cellularity- Unicellular or multicellular b) ultrastructure prokaryotes or eukaryotes (c) Energy and Carbon utilization- Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitats- acquatic or terrestrial (f) Molecular taxonomy three major kingdoms of life.

UNIT II – Genetics: Mendel's laws, Concept of segregation & independent assortment. Concept of llele. Recessiveness and dominance. Single gene disorders in humans–Sickle cell disease, Phenylketonuria.

UNIT III – Biomolecules: Carbohydrates: Types, Structural & functional importance. Lipids: Classification - Simple, compound, & derived, Importance of lipid soluble vitamins. Amino acids – general structure, essential amino acids. Proteins - Levels of protein structure, structural & functional importance of proteins, Enzymes- Definition, Enzyme Activity & UNIT Is, Specific Activity, Specificity, Factors affecting enzyme activity. Nucleic acids: Types and importance.

UNIT IV – Metabolism: Introduction: Food chain & energy flow. Definitions - Anabolism & Catabolism. Photosynthesis: Reaction and importance. Glycolysis & TCA cycle. ATP – the energy currency of cells.

UNIT V – Microbiology: Concept of single celled organisms. Concept of species & strains. Identification & classification of microorganisms. Virus – Definition, types, examples.

TOTAL PERIODS: 60

Text Books

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2018.
2. T Johnson, "Biology for Engineers", CRC press, 2011.
3. J.M. Walker and E.B. Gingold, "Molecular Biology and Biotechnology" 2nd Edition, Panima Publications, 2010.

Reference Books

1. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
2. Alberts Et.Al., "The molecular biology of the cell", 6th Edition, Garland Science, 2014.

Content Beyond Syllabus

- Computational Biology

VII SEMESTER PROFESSIONAL ELECTIVES

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE701	NATURE INSPIRED COMPUTING	3	-	-

Course Pre-requisite

- Familiarity with basic optimization methods

Course Objectives

- To understand the fundamentals of nature inspired techniques To study the Swarm
- Intelligence and Immune computing techniques
- To gain knowledge in inspired computing by nature
- To understand Swarm Intelligence
- To learn computing with new natural materials

Course Outcomes

- The basics Natural systems
- The concepts of Natural systems and its applications
- Basic Natural systems functions(operations)
- Evaluate swarm intelligence with PSO
- Understand Computing with new natural material DNA computing

UNIT I – Introduction: From Nature to Nature Computing , Philosophy , Three Branches: A Brief Overview, Individuals, Entities and agents - Parallelism and Distributive Interactivity ,Adaptation Feedback-Self-Organization-Complexity, Emergence and ,Bottom-up Vs Top-Down- Determination, Chaos and Fractals

UNIT II – Computing Inspired by Nature: Evolutionary Computing, Hill Climbing and Simulated Annealing, Darwin's Dangerous Idea, Genetics Principles, Standard Evolutionary Algorithm – Genetic Algorithms, Reproduction - Crossover, Mutation, Evolutionary Programming Genetic Programming

UNIT III – Swarm Intelligence: Introduction - Ant Colonies, Ant Foraging Behavior, Ant Colony Optimization, SACO and scope of ACO algorithms, Ant Colony Algorithm (ACA), Swarm Robotics, Foraging for food, Social Adaptation of Knowledge , Particle Swarm Optimization (PSO)

UNIT IV – Immuno Computing: Introduction- Immune System, Physiology and main components Pattern Recognition and Binding , Immune Network Theory- Danger Theory, Evaluation Interaction Immune Algorithms , Introduction – Genetic algorithms , Bone Marrow Models , Forest's Algorithm Artificial Immune Networks

UNIT V – Computing With New Natural Materials: DNA Computing: Motivation, DNA Molecule Adleman's experiment , Test tube programming language, Universal DNA Computers , PAM Model Splicing Systems , Lipton's Solution to SAT Problem , Scope of DNA Computing , From Classical to DNA Computing.

TOTAL PERIODS: 60

Text Books

1. Leandro Nunes de Castro, "Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007.

Reference Books

1. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods,and Technologies", MIT Press, Cambridge, MA, 2008.
2. Albert Y. Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006.
3. Marco Dorrigo, Thomas Stutzle," Ant Colony Optimization", PHI, 2005.

Content Beyond Syllabus

- Applying Nature Inspired Computing principles to optimization, design and learning problems

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE702	NATURAL LANGUAGE PROCESSING	3	-	-

Course Pre-requisite

- Proficiency in Python
- Basic Probability and Statistics
- Foundations of Machine Learning

Course Objectives

- To tag a given text with basic Language processing features, design an innovative application using NLP components
- Implement a rule based system to tackle morphology/syntax of a Language
- Design a tag set to be used for statistical processing keeping an application in mind
- Design a Statistical technique for a new application
- Compare and contrast use of different statistical approaches for different types of applications

Course Outcomes

- Acquainted with natural language processing and learn how to apply basic algorithms in this field
- Understand the algorithmic description of the main language levels: morphology, syntax
- Understand semantics, and pragmatics of natural language data - corpora
- Understand basics of knowledge representation, inference
- Elations to the artificial intelligence

UNIT I – Introduction: Regular Expressions -Finite State Automata -Morphology – Finite state transducers-Probabilistic models - N-grams models.

UNIT II – Syntax Analysis: Word classes and Part-of-Speech - Context Free Grammars for English – parsing with context free grammar- Syntax-Features and Unification- Lexicalized and Probabilistic Parsing- Language and Complexity.

UNIT III – Semantic Analysis: Representing Meaning - Meaning Structure of Language - First Order Predicate Calculus - Representing Linguistically Relevant Concepts -Syntax-Driven Semantic Analysis -Semantic Attachments - Syntax-Driven Analyzer - Robust Analysis - Lexemes and Their Senses - Internal Structure - Word Sense Disambiguation -Information Retrieval.

UNIT IV – Pragmatics: Discourse- Reference Resolution - Text Coherence -Discourse Structure - Dialog and Conversational Agents - Natural Language Generation- Machine Translation - Transfer Metaphor – Interlingua – Statistical Approaches.

UNIT V – Information Extraction: Entity recognition- relation detection- temporal expression analysis and template-filling. Question Answering and Summarization: Information retrieval-factoid question answering, single document summarization, - generic multiple document summarization-query-focused summarization.

TOTAL PERIODS: 60

Text Books

1. Daniel Jurafsky and James, H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing Computational Linguistics, and Speech Recognition", 2nd Edition Prentice-Hall, 2009.
2. Tanveer Siddiqui and U.S.Tiwary, "Natural Languge Processing and Information Retrieval", Oxford University Press, 2008.
3. James Allen "Natural Language Understanding", Benjamin / Cummings Publishing Co., 1995.

Reference Books

1. Gros, Jones and Webber, "Readings in Natural Language Processing", MorganKonfmann publishers, 1986.

2. Popov, "Talking with computers in Natural Language"- Springer – Verlag – 1986.
3. E.Reiter and Robert Date "Building Natural Language Generation Systems" Cambridge University Press, 2000.

Content Beyond Syllabus

- Information and Image retrieval using Deep learning

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE703	DEEP REINFORCEMENT LEARNING	3	-	-

Course Pre-requisite

- Machine Learning fundamentals

Course Objectives

- The course aims to provide an understanding of different types of Deep
- Architectures, including Convolution Networks
- Architectures, including Recurrent Networks
- Architectures, including Fast Convolution Neural Networks
- Architectures, including Faster Recurrent Neural Networks

Course Outcomes

- Describe in-depth about theories, models and algorithms in machine learning
- Compare and contrast different learning algorithms with parameters
- Examine the nature of a problem at hand and find the appropriate learning algorithms
- Parameters that can solve it efficiently enough
- Design and implement of deep and reinforcement learning approaches for solving real-life problems

UNIT I – History of Deep Learning: McCulloch Pitts Neuron, Thresholding Logic, Activation functions, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMS Prop, Adam, Eigen values Decomposition. Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs, Encoder Decoder Models, Attention Mechanism, Attention over images.

UNIT II – Auto Encoders: Relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Contractive auto encoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Batch Normalization, Instance Normalization, Group Normalization.

UNIT III – Greedy Layer wise Pre-training: Better activation functions, Better weight initialization methods, Learning Vectorial Representations Of Words, Convolutional Neural Networks, LeNet, AlexNet, ZFNet, VGGNet, GoogLeNet, ResNet, Visualizing Convolution Neural Networks.

UNIT IV – Introduction to Reinforcement Learning(RL): Bandit algorithms – UCB, PAC, Median Elimination, Policy Gradient, Full RL & MDPs, Bellman Optimality, Dynamic Programming – Value iteration, Policy iteration, and Q-learning & Temporal Difference Methods.

UNIT V – Fitted Q: Deep Q-Learning , Advanced Q-learning algorithms , Learning policies by imitating optimal controllers , DQN & Policy Gradient, Policy Gradient Algorithms for Full RL, Hierarchical RL,POMDPs, Actor-Critic Method, Inverse reinforcement learning, Maximum Entropy Deep Inverse Reinforcement Learning, Generative Adversarial Imitation Learning, Recent Trends in RL Architectures.

TOTAL PERIODS: 60

Text Books

1. Ian Good fellow and Yoshua Bengio and AaronCourville, “Deep Learning”, An MIT Press book, 2016.

Reference Books

1. Sutton and Barto, “Reinforcement Learning: An Introduction”, 2nd Edition 2015.
2. Marco Wiering and Martijn van Otterl, “Reinforcement Learning: State-of-the-Art”, March 2014.

Content Beyond Syllabus

- Applying Deep Reinforcement Learning to optimization, design and learning problems in Digital Image Processing.

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE704	AI FOR ROBOTICS	3	-	-

Course Pre-requisite

- Computer Organization and System Architecture
- Data Modeling
- Sound knowledge of programming languages such as Python and R

Course Objectives

- Study the concepts of Artificial Intelligence
- Learn the methods of solving problems using Artificial Intelligence
- Introduce the concepts of Expert Systems and machine learning
- Learn about planning and reasoning artificial intelligence.
- Solve the risk in artificial intelligence

Course Outcomes

- Identify problems that are amenable to solution by AI methods
- Identify appropriate AI methods to solve a given problem
- Formalize a given problem in the language/framework of different AI methods
- Implement basic AI algorithms
- Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports

UNIT I – Introduction: History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning–knowledge representation – first order logic.

UNIT II – Planning: Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

UNIT III – Reasoning: Uncertainity – Probabilistic reasoning–Filtering and prediction– Hidden Markov models–Kalman filters–Dynamic Bayesian Networks, Speech recognition, making decisions.

UNIT IV – Learning: Forms of learning – Knowledge in learning – Statistical learning methods – reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

UNIT V – AI In Robotics: Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence.

TOTAL PERIODS: 60

Text Books

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India 2003.
2. Negnevitsky, M,"Artificial Intelligence: A guide to Intelligent Systems", Harlow: Addison-Wesley, 2002.

Reference Books

1. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992.

Content Beyond Syllabus

- Construction of Robots using Artificial Intelligence principles

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE705	MULTIMODAL SENTIMENT ANALYSIS	3	-	-

Course Pre-requisite

- Basic knowledge about natural language processing

Course Objectives

- To give an overview on the need for sentiment analysis
- To explore the various methodologies necessary to perform sentiment classification
- To learn about opinion summarization
- To learn the various tools used for sentiment analysis
- To gain knowledge in aspect based sentiment analysis

Course Outcomes

- Apply the various algorithms to perform opinion mining and classification
- Identify the sentiment of any document, web-page or social networking site
- Compare and contrast the various tools necessary for performing sentiment analysis
- Use the apt tools to perform sentiment analysis for any given application
- Understand knowledge about sentiment analysis aspects

UNIT I – Introduction: Need for Sentiment Analysis – Problem of Sentiment Analysis - Subjectivity – Stance – Words to Discourse – Pragmatics – Natural Language Processing issues – Opinion Definition – Sentiment analysis Tasks – Opinion Summarization – Types of opinion – Subjectivity and emotion – Author and Reader Standpoint.

UNIT II – Document Sentiment Classification: Sentiment Classification Using Supervised Learning – Unsupervised Learning – Rating Prediction – Cross-Domain Sentiment Classification–Cross Language Sentiment Classification – Sentence Subjectivity and Classification – Subjectivity Classification – Sentence Sentiment Classification – Conditional Sentences Sarcastic Sentences – Cross-Language Subjectivity and Sentiment Classification.

UNIT III – Aspect Based Sentiment Analysis: Aspect sentiment classification – rules of opinions and compositional semantics – aspect extraction – identifying resource usage aspect – simultaneous opinion lexicon expansion and aspect extraction – Grouping aspects into categories – entity, opinion hold and timing extraction – coreference resolution and word sense disambiguation – aspect and entity extraction – sentiment lexicon generation – corpus based approach – dictionary based approach – desirable and undesirable facts.

UNIT IV – Opinion Summarization: Aspect based opinion summarization – improvements to aspect-based opinion summarization –contrastive view summarization – traditional summarization – Analysis of comparative opinions –identifying comparative sentences – identifying preferred entities – opinion search and retrieval –opinion spam detection – types of spam detection - supervised and un-supervised approach –group spam detection.

UNIT V – Tools For Sentiment Analysis: Detecting fake or deceptive opinions - Quality of Review – Quality as regression model – other methods – Case study – sentiment analysis applications – tools for sentiment analysis – Semantria – Meltwater – Google Analytics – Face book Insights – Tweetstats.

TOTAL PERIODS: 60

Text Books

1. Bart Baesens," Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", John Wiley & Sons, 2014.
2. Min Chen, Shiwen Mao, Yin Zhang, Victor CM Leung, Big Data: Related Technologies, Challenges and Future Prospects, Springer, 2014.

Reference Books

3. Michael Minelli, Michele Chambers, Ambiga Dhiraj , "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends", John Wiley & Sons, 2013.
4. Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGI Global.

Content Beyond Syllabus

- Research on Cloud Infrastructures for Big Data Analytics

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE706	COMPUTATIONAL BIOLOGY	3	-	-

Course Pre-requisite

- Basic Knowledge of computing

Course Objectives

- To learn the DNA sequencing and Simulated annealing
- To explore pattern matching and GA concepts
- To learn various models and algorithms related to computation
- To learn SVM and it applications
- To gain knowledge on ANN

Course Outcomes

- To understand DNA sequencing and its application in Bio computing
- To explore GA concepts and its application
- To apply models and algorithms in computation
- Develop applications using ANN
- Trained in the application of Artificial Intelligence in Bio computing

UNIT I – DNA Computing: Motivation, DNA structure, processing and computational operations, steps involved in DNA computation, Filtering models: Adleman's experiment, Lipton's solution, Scope and Applications of DNA computing. Search Algorithms: Hill climbing, Simulated annealing:-introduction Simulated annealing algorithm

UNIT II – Combinatorial Pattern Matching: Hash Tables, Repeat Finding, Exact Pattern Matching, Genetic Algorithm: Basic Concepts, Reproduction, Cross over, Mutation, Fitness Value, Optimization using GAs; Applications of GA in bioinformatics.

UNIT III – Hidden Markov Model: Markov processes and Markov Models, Hidden Markov Models Forward and Backward Algorithms, Most probable state path: Viterbi algorithm, Parameter Estimation for HMMs:-Baum-Welch Algorithm, Applications of profile HMMs for multiple alignment of proteins and for finding genes in the DNA

UNIT IV – Support Vector Machines: Introduction, hyperplane separation (maximum and soft margin hyperplanes), linear classifier, Kernel functions, Large Margin Classification, Optimization problem with SVM, Applications of SVM in bioinformatics. Bayesian network: Bayes Theorem, Inference and learning of Bayesian network, BN and Other Probabilistic Models.

UNIT V – Artificial Neural Network: Historic evolution – Perceptron, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, back propagation algorithm, Applications of ANN

TOTAL PERIODS: 60

Text Books

1. Neil C. Jones, Pavel Pevzner, " An introduction to bioinformatics algorithms" MIT Press, 2004.
2. Richard Durbin, Eddy, Anders Krogh, " Biological sequence analysis: Probabilistic models of proteins and nucleic acids", 1998.
3. Ron Shamir Lecture, "Algorithms for Molecular Biology", Fall Semester, 2001.
4. Raul Rojas, " Neural Networks: A Systematic Introduction", Springer. 1996.
5. N. Yannakakis and Julian Togelius, " Artificial Intelligence and Games" Georgios , Springer 2018.

Reference Books

1. Pierre Baldi, Søren Brunak, "Bioinformatics: the machine learning approach", MITPress. 2001.
2. David Mount , "Bioinformatics: Sequence and Genome Analysis" University of Arizona ,Tucson. 2005.

3. Chapman & Hall , "Fundamentals of natural computing : Basic concepts, Algorithms and Applications" CRC, Taylor & Francis group, 2006.

Content Beyond Syllabus

- To apply models and algorithms in Computational Biology

VIII SEMESTER PROFESSIONAL ELECTIVES

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE801	**DATA MINING AND WAREHOUSING**	**3**	**-**	**-**

Course Pre-requisite

- Knowledge in Database Management System

Course Objectives

- To learn Concepts of data warehouse and data mining
- To get acquainted with the tools and techniques used for mining and classification
- To gain knowledge of clustering and its application
- To build data warehouse and decision support system
- Knowledge Discover in Databases and business analysis

Course Outcomes

- Apply data mining techniques and methods to large data sets
- Compare and contrast the various classifiers in efficient manner
- Use data mining tools in more precise way
- Enable to build data warehouse
- Apply data mining techniques in real time applications

UNIT I – Data Mining: Introduction – Data - Types of Data – Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems – Data Mining Task Primitives – Integration of a Data Mining System with a Data Warehouse – Issues –Data Preprocessing.

UNIT II – Association Rule Mining and Classification: Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining – Classification and Prediction – Basic Concepts – Decision Tree Induction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction.

UNIT III – Clustering and Trends in Data Mining: Cluster Analysis – Types of Data – Categorization of Major Clustering Methods – K-means– Partitioning Methods – Hierarchical Methods – Density-Based Methods –Grid Based Methods – Model-Based Clustering Methods – Clustering High Dimensional Data – Constraint – BasedCluster Analysis – Outlier Analysis – Data Mining Applications.

UNIT IV – Data Warehousing: Data warehousing Components –Building a Data warehouse -Mapping the Data Warehouse to a Multiprocessor Architecture –DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools – Metadata.

UNIT V – Business Analysis: Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Cognos Impromptu – Online Analytical Processing (OLAP) – Need – Multidimensional Data Model – OLAP Guidelines – Multidimensional versus Multi relational OLAP – Categories of Tools – OLAP Tools and the Internet.

TOTAL PERIODS: 60

Text Books

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, Person Education, 2007.
2. K.P. Soman, Shyam Diwakar and V. Aja, “Insight into Data Mining Theory and Practice”, Eastern Economy Edition, Prentice Hall of India, 2006.

Reference Books

1. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Eastern Economy Edition, Prentice Hall of India, 2006.
2. Daniel T.Larose, “Data Mining Methods and Models”, Wiley-Interscience,2006

Content Beyond Syllabus

- Applying Data mining to optimization, design and learning problems

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE802	BUSINESS INTELLIGENCE AND ANALYTICS	3	-	-

Course Pre-requisite

- Knowledge in DBMS

Course Objectives

- To understand the Analytics Life Cycle
- To comprehend the process of acquiring Business Intelligence
- To understand various types of analytics for Business Forecasting
- To model the supply chain management for Analytics
- To apply analytics for different functions of a business

Course Outcomes

- Explain the real world business problems and model with analytical solutions
- Identify the business processes for extracting Business Intelligence
- Apply predictive analytics for business fore-casting
- Apply analytics for supply chain and logistics management
- Use analytics for marketing and sales

UNIT I – Introduction to Business Analytics: Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

UNIT II – Business Intelligence: Data Warehouses and Data Mart - Knowledge Management – Types of Decisions – Decision Making Process - Decision Support Systems – Business Intelligence – OLAP –, Analytic functions

UNIT III – Business Forecasting: Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modeling – Machine Learning for Predictive analytics.

UNIT IV – HR & Supply Chain Analytics: Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain

UNIT V – Marketing & Sales Analytics: Marketing Strategy, Marketing Mix, Customer Behavior – selling Process – Sales Planning – Analytics applications in Marketing and Sales

TOTAL PERIODS: 60

Text Books

1. R. Evans James, "Business Analytics", 2017
2. R N Prasad, Seema Acharya," Fundamentals of Business Analytics", 2016.
3. Philip Kotler and Kevin Keller, "Marketing Management", 15th edition, PHI, 2016.

Reference Books

1. VSP RAO, "Human Resource Management", 3rd Edition, Excel Books, 2010.
2. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education, 2018.

Content Beyond Syllabus

- Applying Business Intelligence And Analytics principles to optimization, design and learning problems.

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE803	C# and Dot NET PRGORAMMING	3	1	-

Course Pre-requisite

- Knowledge in C and C++ Programming

Course Objectives

- To learn basic programming in C# and the object oriented programming concepts
- To enrich with advanced C# features
- To update and enhance skills in writing Windows applications, ADO.NET and ASP .NET
- To study the advanced concepts in data connectivity, WPF, WCF and WWF
- To learn .NET Framework and develop applications

Course Outcomes

- Write various applications using C# Language in the .NET Framework
- Develop distributed applications using .NET Framework
- Gain knowledge and develop applications using WCF and WWF
- Create mobile applications using .NET compact Framework
- Develop an application in .Net Framework

UNIT I – C# Language Basics: .Net Architecture – Core C# – Variables – Data Types – Flow control – Objects and Types- Classes and Structures – Inheritance- Generics – Arrays and Tuples – Operators and Casts – Indexers.

UNIT II – C# Advanced Features: Delegates – Lambdas – Lambda Expressions – Events – Event Publisher – Event Listener – Strings and Regular Expressions – Generics – Collections – Memory Management and Pointers – Errors and Exceptions – Reflection.

UNIT III – Base Class Libraries and Data Manipulation: Diagnostics - Tasks, Threads and Synchronization – .Net Security – Localization – Manipulating XML- SAX and DOM – Manipulating files and the Registry- Transactions – ADO.NET- Peer-to-Peer Networking – PNRP – Building P2P Applications – Windows Presentation Foundation (WPF).

UNIT IV – Window Based Applications, WCF AND WWF: Window based applications – Core ASP.NET- ASP.NET Web forms -Windows Communication Foundation (WCF)- Introduction to Web Services – .Net Remoting – Windows Service – Windows Workflow Foundation (WWF) – Activities – Workflows.

UNIT V – .Net Framework and Compact Framework: Assemblies – Share assemblies – Custom Hosting with CLR Objects – App domains – Core XAML – Bubbling and Tunneling Events- Reading and Writing XAML – .Net Compact Framework – Compact Edition Data Stores – Errors, Testing and Debugging – Optimizing performance – Packaging and Deployment – Networking and Mobile Devices.

TOTAL PERIODS: 60

Text Books

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner. "Professional C# 2012 and .NET 4.5", Wiley, 2012.
2. Harsh Bhasin, "Programming in C#", Oxford University Press, 2014.

Reference Books

1. Ian Gariffiths, Mathew Adams, Jesse Liberty, "Programming C#4.0", OReilly, Fourth Edition, 2010.
2. Andrew Troelsen, "Pro C# 5.0 and the .NET 4.5 Framework", Apress publication,2012.
3. Andy Wigley, Daniel Moth, Peter Foot, "Mobile Development Handbook", Microsoft Press, 2011.

Content Beyond Syllabus

- Mobile Application Development

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE804	VIRTUAL REALITY AND AUGMENTED REALITY	3	-	-

Course Pre-requisite

- Basic programming skills

Course Objectives

- To introduce the virtual reality technology and techniques
- To learn the relevance of existing technology through demonstrations of VR
- To develop case studies and applications with a futuristic vision along with socio - economic impact and issues of VR
- To know the intricacies of these platform to develop PDA applications with better optimality
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications

Course Outcomes

- Analyze & Design a system or process to meet given specifications with realistic engineering constraints using VR
- Identify problem and design the model using VR
- How to create content using VR and AR
- Develop mobile applications
- Utilize technical resources for real time applications

UNIT I – Introduction: The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation- interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

UNIT II – VR Development Process: Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

UNIT III – Content Creation Considerations for VR: Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment.

UNIT IV – VR on the Web & VR on the Mobile: JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)- frameworks (A-frame, React VR)-Google VR for Android-Scripts mobile device configuration, building to android- cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics.

UNIT V – Applications: Medical applications-military applications – robotics applications-Advanced Real time Tracking- other applications- games, movies, simulations, therapy.

TOTAL PERIODS: 60

Text Books

1. C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008
2. Jason Jerald. " The VR Book: Human-Centred Design for Virtual Reality", Association for Computing Machinery and Morgan & Claypool, New York, NY, USA, 2015.

Reference Books

1. Dieter Schmalstieg & Tobias Hollerer, "Augmented Reality: Principles and Practice (Usability)", Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575
2. Steve Aukstakalnis, Addison-Wesley "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)", 1st Edition, 2016.
3. Robert Scoble & Shel Israel, "The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything", Patrick Brewster Press, 1st Edition, 2016.
4. Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile", O'Reilly Media; 1st Edition, 2015.
5. Tony Parisi, "Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages", O'Reilly Media, 1st Edition, 2014.
6. Jos Dirksen, "Learning Three.js: The JavaScript 3D Library for WebGL" – Second Edition, Packt Publishing - ebooks Account; 2nd Revised Edition 2015.

Content Beyond Syllabus

- Working knowledge of geometry, 3D space, and linear algebra

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE805	BIG DATA ANALYTICS FOR IoT	3	-	-

Course Pre-requisite

- Basic understanding of big data and IoT

Course Objectives

- To learn the concepts of big data analytics
- To learn the concepts about Internet of things
- To understand the concepts of big data management
- To understand and implement smart systems
- To gain knowledge on data analytics

Course Outcomes

- Understand the use of big data for IoT
- Able to apply RFID in real time applications
- Develop big data management systems
- Ability to analyze and implement smart systems.
- Clear view on sustainable data analytic in cloud.

UNIT I – Big Data Platforms For The Internet of Things: Big Data Platforms for the Internet of Things: network protocol- data dissemination – current state of art - Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments – Big Data challenges and requirements coming from different Smart City applications.

UNIT II – RFID False Authentications: On RFID False Authentications: YA TRAP – Necessary and sufficient condition for false authentication prevention - Adaptive Pipelined Neural Network Structure in Self-aware Internet of Things: self-healing systems, Role of adaptive neural network- Spatial Dimensions of Big Data: Application of Geographical Concepts and Spatial Technology to the Internet of Things- Applying spatial relationships, functions, and models

UNIT III – Big Data Management: A Platform for Internet of Things and Analytics: a massively distributed number of sources - Big Data Metadata Management in Smart Grids: semantic inconsistencies – role of metadata

UNIT IV – Web Enhanced Building: Toward Web Enhanced Building Automation Systems: heterogeneity between existing installations and native IP devices - loosely-coupled Web protocol stack –energy saving in smart building- Intelligent Transportation Systems and Wireless Access in Vehicular Environment Technology for Developing Smart Cities: advantages and achievements- Emerging Technologies in Health Information Systems: Genomics Driven Wellness Tracking and Management System (GO-WELL) – predictive care – personalized medicine

UNIT V – Sustainability Data and Analytics: Sustainability Data and Analytics in Cloud-Based M2M Systems – potential stakeholders and their complex relationships to data and analytics applications - Social Networking Analysis - Building a useful understanding of a social network - Leveraging Social Media and IoT to Bootstrap Smart Environments: lightweight Cyber Physical Social Systems – citizen actuation.

TOTAL PERIODS: 60

Text Books

1. NikBessis, CiprianDobre, "Big Data and Internet of Things: A Roadmap for Smart Environments" Springer, 2001.
2. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.," Big Data and the Internet of Things Enterprise Information Architecture for A New Age", Apress, 2015.

Reference Books

1. John Bates, "Thing analytics - Smart Big Data Analytics for the Internet of Things", John Bates, Software AG; 1st Edition 2015.

Content Beyond Syllabus

- Working knowledge in Big Data Analytics For IOT

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI PE806	INFORMATION SECURITY	3	-	-

Course Pre-requisite

- Familiarity with software engineering

Course Objectives

- To understand the basics of Information Security
- To know the legal, ethical and professional issues in Information Security
- To know the aspects of risk management
- To become aware of various standards in this area
- To know the technological aspects of Information Security

Course Outcomes

- Discuss the basics of information security
- Illustrate the legal, ethical and professional issues in information security
- Demonstrate the aspects of risk management
- Become aware of various standards in the Information Security System
- Design and implementation of Security Techniques

UNIT I – Overview of Computer Security: The Basic Components- Confidentiality, integrity and availability; Security policy and procedure; Assumptions and Trust; Security Assurance, Implementation and operational issues; Security Life Cycle -Access Control Models: Role based Model.

UNIT II – Security Policies and System Design: Types of Security Policies- Confidentiality policies: Goals of Confidentiality Policies, The Bell-LaPadula Model Integrity policies: Biba Integrity Model, Clark-Wilson Integrity Model -Hybrid policies: Chinese Wall Model, Clinical Information Systems Security Policy. Access Control Mechanisms: Access Control Lists- information Flow: Compiler-Based Mechanisms, Execution-Based Mechanisms- Confinement Problem: Isolation, Covert Channels Assurance: Building Secure and Trusted Systems- Evaluating Systems: Goals of Formal Evaluation.

UNIT III – SYSTEM SECURITY: Malicious Logic: Trojan Horses, Computer Viruses, Computer Worms-Vulnerability Analysis: Penetration Studies, Vulnerability Classification-Auditing: Anatomy of an Auditing System, Auditing Mechanisms, Audit Browsing Intrusion Detection: Architecture, Organization of Intrusion Detection Systems- Design Principles- Representing Identity: Files and Objects, Users, Groups and Roles, Naming and Certificates.

UNIT IV – APPLICATIONS: Network Security: Policy Development, Network Organization- System Security: Policy- User Security: Policy, Access, Files and Devices- Program Security: Requirements and Policy, Design, Case Study: Common Security Related Programming Problems.

UNIT V – OPERATING SYSTEM AND DATABASE SECURITY: Operating System Security: Security Architecture, Analysis of Security in Linux/Windows-Database Security: Security Architecture, Database Auditing-Case Study: Discretionary Access Control.

TOTAL PERIODS: 60

Text Books

1. Ross Anderson, "Security Engineering: A Guide to Building Dependable Distributed Systems", Third Edition, Wiley, 2021.
2. M. Bishop, "Computer Security: Art and Science", 2nd Edition, Pearson Education, 2019.
3. M. Stamp, "Information Security: Principles and Practice", 2nd Edition, Wiley, 2011.

Reference Books

1. C.P. Pfleeger, S.L. Pfleeger, J. Margulies, "Security in Computing", 5th Edition, Prentice Hall, 2015.
2. David Wheeler, "Secure Programming HOW TO", v3.010 Edition, 2003.
3. Michael Zalewski, "Browser Security Handbook", Google Inc., 2009.
4. M. Gertz, S. Jajodia, "Handbook of Database Security", Springer, 2008.rson/PHI, 2002.

Content Beyond Syllabus

- Network security
- Cyber security

OPEN ELECTIVES

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE901	**BIO INFORMATICS**	**3**	**-**	**-**

Course Pre-requisite

- Knowledge in Bio-Inspired Databases
- Basics of Biological sequences

Course Objectives

- To gain knowledge about Biological facts used
- To gain the database sequence with protein content
- To understand the biological formation and their transformations
- To know about protein structure
- To understand the phylogenetics

Course Outcomes

- Understand emerging abstract models for Bioinformatics Technology
- Analyze the concept of DNA and RNA background behind it
- Apply the tools for understanding of DNA and RNA sequence
- Identify research challenges and technical gaps in Protein database
- Understanding of latest advances and its applications in Bioinformatics

UNIT I – Introduction of Bioinformatics: Definition – Challenges in Bioinformatics - Internet and bioinformatics – Molecular biology's central dogma – DNA, RNA and proteins – Genes and Genomes – Representation of DNA, RNA and protein structures – codons and anti codons – open reading frames (ORF) – exons and introns – software tools for bioinformatics.

UNIT II – Literature Databases: Public databases and data formats, popular gene and protein databases – Sequence alignment and sequence searching – Database search strategies – querying strategy, similarity searching vs homology – popular tools for database searching and querying – FETCH, LOOKUP, ENTREZ, Net FETCH, BLAST, FASTA – interpretation of results.

UNIT III – Pairwise Alignment: Problem definition & biological motivation – similarity and differences – global alignment, local alignment – gap penalty models- substitution matrices – PAM, BLOSUM – Applying dynamic programming to pairwise alignment – Needleman – WUNSCH algorithm, Smith – waterman algorithm.

UNIT IV – Multiple Sequence Alignment: Computational challenges – Dynamic programming solution – approximation algorithms – center star, distance from consensus, sum of pairs progressive alignment, multiple alignment to a phylogenic tree – Tools for Multiple sequence alignment – CLUSTALW.

UNIT V – Phylogenetic Analysis: Bais Definitions – From MSA to phylogenetics – Phylogenetic tree construction distance based methods – UPGMA, Neighbor joining – Character based methods – maximum parsimony - fitch algorithm methodologies, weighted parsimony – sankoff's algorithm, maximum likelihood, tools for phylogenetic tree construction PAUP, PHYLIP

TOTAL PERIODS: 60

Text Books

1. Sundararajan, R. Balaji, "Introduction to Bioinformatics", Himalaya Publishing House, 2002.

Reference Books

1. Rastogi S C, Namita Mendiratta and Parag Rastogi, "Bioinformatics - Concepts, Skills, Applications", CBS Publications & Distributors, New Delhi, 2003.
2. Teresa Attwood, David Parry-Smith, "Introduction to Bioinformatics", Pearson Education, New Delhi, 2001.

Content Beyond Syllabus

- DNA and RNA Sequence Application Development
- Apps will be built on Protein Database

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE902	CLOUD COMPUTING	3	-	-

Course Pre-requisite

- DBMS
- Data Structures
- Computer Network

Course Objectives

- To understand the Service Model with reference to Cloud Computing
- To comprehend the Cloud Computing architecture and implementation
- To realize the role of Virtualization Technologies
- To have knowledge on Cloud Computing management and security
- To have knowledge on Cloud services in daily real time projects

Course Outcomes

- Describe the concept, evolution, architecture, pros and cons of Cloud Computing
- Have knowledge of how hypervisors are used in Virtual Machines
- To secure and perform identity management in the Cloud
- To access and use the services in the Cloud
- Understanding of latest advances and its applications in cloud computing

UNIT I – Introduction to Cloud Computing: Overview, Roots of Cloud Computing, Layers and Types of Cloud, Desired Features of a Cloud, Benefits and Disadvantages of Cloud Computing, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platformas a Service Providers, Challenges and Risks, Assessing the role of Open Standards.

UNIT II – Cloud Architecture, Services and Applications: Exploring the Cloud Computing Stack, connecting to the Cloud, Infrastructure as a Service, Platform as a Service, Saas Vs. Paas, Using PaaS Application Frameworks, Software as a Service, Identity as a Service, Compliance as a Service.

UNIT III – Abstraction and Virtualization: Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding Hyper visors, Understanding Machine Imaging, Porting Applications, Virtual Machines Provisioning and Manageability Virtual Machine Migration Services, Virtual Machine Provisioning and Migration in Action, Provisioning in the Cloud Context.

UNIT IV – Managing & Securing the Cloud: Administrating the Clouds, Cloud Management Products, Emerging Cloud Management Standards, Securing the Cloud, Securing Data, Establishing Identity and Presence.

UNIT V – Case-Studies: Using Google Web Services, Using Amazon Web Services, Using Microsoft Cloud Services.

TOTAL PERIODS: 60

Text Books

1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", First Edition, John Wiley & Sons, 2011.
2. Sosinsky B., "Cloud Computing Bible", First Edition, Wiley Edition, 2011.

Reference Books

1. Miller Michael, "Cloud Computing: Web Based Applications that Change the Way You Work and Collaborate Online", Pearson Education India, 2008.
2. Smooth S., Tan N., "Private Cloud Computing", Morgan Kauffman , First Edition,2011
3. Linthicium D., "Cloud Computing and SOA Convergence in Enterprise", Pearson Education India, 2009.

Content Beyond Syllabus

- Working with CLOUD platform
- Access PaaS, SaaS services

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE903	FOG AND EDGE COMPUTING	3	-	-

Course Pre-requisite

- Knowledge in any programming language with problems solving skills with good understanding of Networking and IoT
- Basics of cloud computing

Course Objectives

- To become familiar with the concepts of Fog and Edge computing
- To understand the architecture and its components and working of components and its Performance
- To explore Fog and Edge computing on security, multimedia and smart data
- To create a model in Fog and Edge computing scenario
- To have knowledge on Cloud and Edge services in real time projects

Course Outcomes

- Understand the use of IoT architecture with its entities and protocols via Edge and Fog, up to the cloud
- Get familiar on security & privacy issues related to area of Fog & Edge computing, IoT, and big data.
- Exploit Fog and Edge computing in implementing real time applications
- To access and use the services in the Cloud
- Understanding of latest advances and its applications in cloud, Fog and Edge computing

UNIT I – Introduction to Fog and Edge Computing: Fog and Edge Computing(FEC) - Definition-FEC Completing the Cloud - Advantages of FEC- Hierarchy of FEC-Business Models - Opportunities and Challenges- Addressing the Challenges in Federating Edge Resources – Introduction – The networking challenge- The management challenge.

UNIT II – Middleware: Introduction-Need for Fog and Edge Computing Middleware- Design Goals-State-of-the-Art Middleware Infrastructures-System Model- Proposed Architecture-Case Study Example-Future Research Directions. Lightweight Container Middleware for Edge Cloud Architectures-Introduction-Clusters for Lightweight Edge Clouds-Architecture Management – Storage and Orchestration- IoT Integration- Security Management for Edge Cloud Architectures -Future Research Directions.

UNIT III – Data Management and Predictive Analysis in Fog Computing: Problem definition & biological motivation – similarity and differences – global alignment, local alignment – gap penalty models-substitution matrices – PAM, BLOSUM – Applying dynamic programming to pairwise alignment – Needleman – WUNSCH algorithm, Smith – waterman algorithm.

UNIT IV – Optimization Problems in Fog and Edge Computing: The Case for Optimization in Fog Computing – Formal Modeling- Framework for Fog Computing Metrics -Optimization Opportunities along the Fog Architecture - Optimization Opportunities along the Service Life Cycle – Toward a Taxonomy of Optimization Problems in Fog Computing -optimization Techniques.

UNIT V – Case Studies: Smart Surveillance Video Stream Processing at the Edge for Real-Time -Smart Transportation Applications-Intelligent Traffic Lights Management (ITLM) System -Fog Orchestration Challenges and Future Directions.

TOTAL PERIODS: 60

Text Books

1. Rajkumar Buyya, Satish Narayana Srirama, “Fog and Edge Computing: Principles and Paradigms”, Wiley series on Parallel and Distributed Computing, 2019.

Reference Books

1. Flavio Bonomi, Rodolfo Milito, Preethi Natarajan and Jiang Zhu "Fog Computing: A Platform for Internet of Things and Analytics", Springer International. 2011.
2. FlavioBonomi, Rodolfo Milito,Jiang Zhu, Sateesh Addepalli, MCC‟ "Fog Computing and Its Role in the Internet of Things", , Helsinki, Finland, 12, August 17, 2012
3. Shanhe Yi, Cheng Li, Qun Li, Mobidata‟, Hangzhou "A Survey of Fog Computing: Concepts, Applications and Issues , China. 15, June 21, 2015

Content Beyond Syllabus

- Energy Harvesting Technologies and Power Management

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE904	WIRELESS COMPUTING	3	-	-

Course Pre-requisite

- Knowledge in Computer Networks
- Basics of mobile computing

Course Objectives

- To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios
- To study the various protocols at various layers and its differences with traditional protocols
- To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network
- To create a model in wireless computing
- To have knowledge on applications wireless networks in real time projects

Course Outcomes

- How to build a WSN network
- Analysis of various critical parameters in deploying a WSN
- Classify different types of mobile telecommunication systems
- Demonstrate the Adhoc networks concepts and its routing protocols
- Make use of mobile operating systems in developing mobile applications

UNIT I - Introduction: Wireless networking- Physical layer- OFDM and 802.11 (WiFi) PHY - Multi-antenna systems and MIMO- Overview of 802.11n/ac PHY including beamforming- MAC layer - CSMA/CA and WiFi MAC overview - Wide bandwidth channel access techniques (802.11n/ac)- Energy efficiency and rate control.

UNIT II – Mobile and wearable sensing: Overview of smartphone/wearable sensors -Accelerometer, gyroscope, magnetometer etc. - Smartphone orientation and heading detection. Activity recognition and healthcare - Identifying human activities and context through sensors - Health monitoring and fitness tracking Wearables overview- Wrist-worn wearables.

UNIT III – Multi-gigabit wireless networks: Millimeter wave networking - Directionality and beam forming - Mobility and signal blockage - IEEE 802.11ad (60 GHz WLAN) MAC and PHY overview-Visible light communication - High-speed networking using LED - IEEE 802.15.7 PHY and MAC overview-Sensing through visible light- Visible light indoor localization and positioning.

UNIT IV – Routing Protocols: The Case for Optimization in Fog Computing- Formal Modeling-Framework for Fog Computing Metrics -Optimization Opportunities along the Fog Architecture - Optimization Opportunities along the Service Life Cycle - Toward a Taxonomy of Optimization Problems in Fog Computing -optimization Techniques.

UNIT V – QoS and Energy Management: Smart Surveillance Video Stream Processing at the Edge for Real-Time -Smart Transportation Applications-Intelligent Traffic Lights Management (ITLM) System -Fog Orchestration Challenges and Future Directions.

TOTAL PERIODS: 60

Text Books

1. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", Prentice Hall, 2010.
2. Matthew Gast, "802.11n: A Survival Guide", O'Reilly Media, 2012.
3. Matthew Gast, "802.11ac: A Survival Guide", O'Reilly Media, 2013.
4. Pei Zhengetal., Morgan Kaufmann, "Wireless Networking Complete", 2009.

Reference Books

1. C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education, 2008.
2. Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication, 2004.
3. Jochen Schiller, "Mobile Communications", Pearson Education, 2nd Edition, 2003.
4. William Stallings, "Wireless Communications and Networks ", Pearson Education, 2004.

Content Beyond Syllabus

- Surveillance and Monitoring for Detection
- Wireless sensor network in Agriculture

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE905	PERVASIVE COMPUTATION	3	-	-

Course Pre-requisite

- Knowledge in network protocols
- Basics of Sensor networks

Course Objectives

- To understand the characteristics and principles of Pervasive computing and the solutions that are in use
- To realize the role of wireless protocols in shaping the future Internet
- To understand the issues pertaining to sensor and wireless networks and the challenges involved in managing a sensor network
- To design and implement pervasive applications
- To introduce the enabling technologies of pervasive computing

Course Outcomes

- Outline the basic problems, performance requirements of pervasive computing applications, and the trends of pervasive computing and its impacts on future computing applications and society
- Analyze and compare the performance of different data dissemination techniques and algorithms form obile real-time applications
- Analyze the performance of different sensor data management and routing algorithms for sensor networks
- Understand the aspects of context awareness
- Understand the fundamental theoretical concepts in pervasive computing

UNIT I – Introduction: Pervasive Computing - Principles, Characteristics - interaction transparency, context aware, automated experience capture. Architecture for pervasive computing- Pervasive devices-embedded controls –smart sensors and actuators-Context communication and access services.

UNIT II – Protocols: Open protocols-Service discovery technologies-SDP, Jini, SLP, UpnPprotocols–data synchronization-SyncML framework-Context aware mobile services Context aware sensor networks, addressing and communications-Context aware security.

UNIT III – Technologies: Past, Present and Future-Device Technology-Device Connectivity- Web Application Concepts-WAP and Beyond-Voice Technologies-Personal Digital Assistants.

UNIT IV – Architecture: Server-side programming in Java - Pervasive Web Application Architecture-Example Application - Access via PCs-Access via WAP- Access via PDA and Voice.

UNIT V – Examples: Smart Tokens, Heating Ventilation and Air Conditioning, Set Top Boxes, Appliances and Home Networking, Residential Gateway, Automotive Computing, On Board Computing Systems, In Vehicle networks, Entertainment Systems

TOTAL PERIODS: 60

Text Books

1. Jochen Burkhardt, “Pervasive Computing: Technology and Architecture of Mobile Internet Applications”, Addison-Wesley Professional; 3rd Edition, 2007

Reference Books

1. SengLoke, “ Context-Aware Computing Pervasive Systems”, Auerbach Pub., New York, 2007.
2. Uwe Hansmannetl, “Pervasive Computing”, Springer, New York, 2001.
3. Jochen Burkhardt, StefanHepper, KlausRindtorff, Thomas Schaeck ”Pervasive Computing-Technology and Architecture of Mobile Internet Application”, Pearson Education, Sixth Edition2009.

Content Beyond Syllabus

- Graph theory on Molecular biology
- Knight's tour problem using Graph Theory

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE906	MOBILE COMPUTING	3	-	-

Course Pre-requisite

- Knowledge In Mobile Transmission
- Basics Of Mobile Devices

Course Objectives

- To teach the concepts of computer networks
- The primary objective of this course is to cover the Wireless network standards, Protocols in Mobile networking, Transactions through Mobile, Client Server Model in Mobile
- The course will enable an individual to learn, how the tools work for Mobile Applications
- To create a model in wireless computing
- To have knowledge on applications wireless networks in real time projects

Course Outcomes

- Explain the basics of wireless networks and mobile computing
- Describe the functionality of Mobile IP and Transport Layer
- Classify different types of mobile transactions
- Demonstrate the Adhoc networks concepts and its routing protocols
- Make use of mobile operating systems in developing mobile applications

UNIT I – Introduction: Wireless and Mobile Computing Architecture – Limitations of wireless and mobile communication – Wireless Telecommunication Networks: Digital cellular Systems, TDMA - CDMA – Wireless Networking Techniques –Mobility Bandwidth Tradeoffs – Portable Information Appliances.

UNIT II – Emerging Wireless Network Standards: 3 G Wireless Networks – State of Industry – Mobility support Software – End User Client Application – Mobility Middleware –Middleware for Application Development - Adaptation and Agents - Service Discovery Middleware - Finding Needed Services - Interoperability and Standardization.

UNIT III – Mobile Networking: Virtual IP Protocols - Loose Source Routing Protocols - Mobile IP – CDPD – GPRS – UMTS - Security and Authentication – Quality of Service – Mobile Access to the World Wide Web

UNIT IV – Mobile Data Management: Mobile Transactions - Reporting and Co Transactions –Kangaroo Transaction Model - Clustering Model –Isolation only transaction – 2 Tier Transaction Model – Semantic based nomadic transaction processing.

UNIT V – Mobile Computing Models: Client Server model – Client/Proxy/Server Model – Disconnected Operation Model – Mobile Agent Model – Thin Client Model – Tools: Java, Brew, Windows CE, WAP, Sybian, and EPOC.

TOTAL PERIODS: 60

Text Books

1. Reza B Fat and Roy.T. Fielding, “Mobile Computing Principles”, Cambridge University Press, 2005
2. Abdelsalam A Helal, Richard Brice, Bert Haskel, Marek Rusinkiewicz, Jeffery L Caster and Darel Woelk, “Anytime, Anywhere Computing, Mobile Computing Concepts and Technology”, Springer International Series in Engineering and Computer Science, 2000.

Reference Books

1. Golden Richard, Frank Adelstein, Sandeep KS Gupta, Golden Richard and Loren Schwiebert, “Fundamentals of Mobile and Pervasive Computing”, McGraw-Hill Professional Publishing”, 2005.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003.

Content Beyond Syllabus

- Mobile Computing with recent technologies
- Various mobile sub system process improvements

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE907	SOFTWARE TESTING	3	-	-

Course Pre-requisite

- Knowledge in Software Testing
- Basics of Software Debugging and its Applications

Course Objectives

- Understand how to detect, classify, prevent and remove defects
- Understand how to conduct formal inspections, record and evaluate results of inspections
- Understand the effectively strategies of testing, the methods and technologies of software testing
- Understanding the testing strategies
- Understand the concepts of milestone for controlling and monitoring

Course Outcomes

- Understand how to detect, classify, prevent and remove defects
- Understand how to conduct formal inspections, record and evaluate results of inspections
- Understand the effectively of testing, the methods and technologies of software testing
- To implement different testing strategies
- Describe controlling and monitoring

UNIT I – Software testing: The Role process in Software Quality- Testing as a process- Overview of testing maturity model, software testing definition- Software Testing Principles –Origin of defects, Defect classes, the defect Repository and Test Design

UNIT II – Testing Strategies: Testing design strategies, Test case design strategies, Black box testing, Random Testing, Equivalence partitioning, Boundary value analysis , Cause-and- Effect, State transition, Error Guessing, COTS, White box testing techniques - Statement coverage - Branch Coverage - Condition coverage - Decision/Condition coverage - Multiple condition coverage - Dataflow coverage - Mutation testing

UNIT III – The Need for Levels of Testing: Unit test, Planning, Designing the unit tests, Integration test, Integration Strategies for Procedure and Functions, Integration strategies for Classes, Integration test planning, System Test: Functional Testing, Performance Testing, Stress Testing, Configuration Testing, Security Testing, Recovery Testing, Regression testing, Alpha, Beta and Acceptance Tests.

UNIT IV – Testing Object Oriented Software: Unit Testing in OO Context, Integration Testing in OO Context, OO testing methods, Class level testing, interclass test case design, testing for real time system

UNIT V – Controlling and Monitoring: Measurements and Milestone for Controlling and Monitoring: Status, Productivity, Cost, Error, fault and Failures, Effectiveness, Criteria for Test Completion, Reviews as testing Activity: Inspection Walkthrough, Components of review plan, testing for web application, Component level testing, and Clean room tests.

TOTAL PERIODS: 60

Text Books

1. Ilene Burnstein, “Practical Software Testing”, Springer-Verlag First Indian Reprint 2004.

Reference Books

1. Ali Behforooz, Frederick J Hudson, “Software Engineering Fundamentals”, Oxford University Press, New York, 2003.
2. William Perry, “Effective Methods for Software Testing”, John Wiley & Sons, Second edition, USA, 2000.
3. Roger S Pressman, “Software Engineering – A Practitioner’s Approach”, McGraw Hill, Sixth Edition, 2006.

Content Beyond Syllabus

- SDLC and Testing
- Metrics and Test case generators

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE908	SOFTWARE PROJECT MANAGEMENT	3	-	-

Course Pre-requisite

- Knowledge in Software Engineering
- Basics of Software life cycle

Course Objectives

- Introducing the primary important concepts of project management related to managing software development projects
- They will also get familiar with the different activities involved in Software Project Management
- Further, they will also come to know how to successfully plan and implement a software project management activity, and to complete a specific project in time with the available budget
- To study about project management, planning and software development process
- To understand about project scheduling and tracking concepts

Course Outcomes

- Identify the different project contexts and suggest an appropriate management strategy
- Practice the role of professional ethics in successful software development
- Identify and describe the key phases of project management
- Determine an appropriate project management approach through an evaluation of the business context and scope of the project
- Describe project scheduling and project tracking

UNIT I – Software Process: Process Maturity – Capability Maturity Model (CMM) – KPA Project Management, Variations in CMM - Productivity improvement process

UNIT II – People Management: Organization structure – Difficulties in people management - Effective team building – Role of Project manager - Team structures – Comparison of different team structures Software Metrics: Role of Metrics In Software Development - Project Metrics – Process Metrics – Data Gathering - Analysis Of Data For Measuring Correctness, Integrity, Reliability And Maintainability Of Software Products.

UNIT III – Project Management and Planning: Project initiation – standard process, Process Tailoring - Feasibility study - Planning – Estimation - Resource allocation - the project Plan – Software Development Process – Defects – Finding Defects – Code Review Checklist – Projecting Defects Inspection And Review Need- Process of Inspection- SRS- Design Document Inspection

UNIT IV – Project Scheduling and Tracking: Scheduling - Critical path – Tracking - Timeline chart - Earned value chart. Software Configuration Management: Baselines - Software configuration items -The SCM process - Version control - Change control - Configuration audit - SCM standards

UNIT V – Working Capital Policy: Importance of Working Capital Management – Risk- Risk analysis and management – Types of Risk involved - RMM plan- Return Tradeoff for Current Asset Investments – Financing Current Assets – The Costs and Risks of Alternative Debt Maturities. Quality Planning: Quality process - Quality control –Defect preventive process- Total Quality Management.

TOTAL PERIODS: 60

Text Books

1. Pankaj Jalote, "Software Project Management in Practice", Pearson Education, New Delhi, 2002.
2. Krish Rangarajan and Anil Misra, "Working Capital Management", Excel Book, New Delhi,2005

Reference Books

1. Watts Humphrey, "Managing the Software Process", Pearson Education, New Delhi, 2005.
2. Roger S Pressman, "Software Engineering – A Practitioner's Approach", McGraw Hill International Edition, Singapore, Sixth Edition, 2007.
3. Hughes, "Software Project Management", Tata McGraw-Hill, 2004

Content Beyond Syllabus

- The COCOMO cost estimation model.
- Various sub system process improvements

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE909	GRAPH THEORY AND APPLICATIONS	3	-	–

Course Pre-requisite

- Knowledge in Graphs
- Basics of Data Structures

Course Objectives

- To understand fundamentals of graph theory
- To study proof techniques related to various concepts in graphs
- To explore modern applications of graph theory.
- To understand the Matrix representation and Graph coloring
- To understand graph algorithms

Course Outcomes

- Understand the basic concepts of graphs, and different types of graphs
- Understand the properties, theorems and be able to prove theorems
- Apply suitable graph model and algorithm for solving applications
- Apply different matrix representations
- Design graph algorithms in all aspects

UNIT I – Introduction: Graph Terminologies - Types of Graphs - Sub Graph- Multi Graph - Regular Graph - Isomorphism - Isomorphic Graphs - Sub-graph - Euler graph - Hamiltonian Graph - Related Theorems.

UNIT II – Trees -Properties- Distance and Centers - Types - Rooted Tree-- Tree Enumeration- Labeled Tree - Unlabeled Tree - Spanning Tree - Fundamental Circuits- Cut Sets - Properties - Fundamental Circuit and Cut-set- Connectivity- Separability -Related Theorems.

UNIT III – Network Flows - Planar Graph - Representation - Detection - Dual Graph - Geometric and Combinatorial Dual - Related Theorems - Digraph - Properties - Euler Digraph.

UNIT IV – Matrix Representation - Adjacency matrix- Incidence matrix- Circuit matrix - Cut-set matrix - Path Matrix- Properties - Related Theorems - Correlations. Graph Coloring - Chromatic Polynomial - Chromatic Partitioning - Matching - Covering - Related Theorems.

UNIT V – Graph Algorithms- Connectedness and Components- Spanning Tree- Fundamental Circuits- Cut Vertices- Directed Circuits- Shortest Path - Applications overview.

TOTAL PERIODS: 60

Text Books

1. Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science",Prentice-Hall of India Pvt.Ltd, 2003.
2. L.R.Foulds , "Graph Theory Applications", Springer ,2016

Reference Books

1. Bondy, J. A. and Murty, U.S.R., "Graph Theory with Applications", North Holland Publication, 2008.
2. West, D. B, “Introduction to Graph Theory”, Pearson Education, 2011.
3. John Clark, Derek Allan Holton, “A First Look at Graph Theory”, World Scientific Publishing Company, 1991.
4. Diestel, R, "Graph Theory", Springer,3rd Edition,2006
5. Kenneth H.Rosen, "Discrete Mathematics and Its Applications", Mc Graw Hill, 2007.

Content Beyond Syllabus

- Graph theory on Molecular biology
- Knight’s tour problem using Graph Theory

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE910	BLOCKCHAIN TECHNOLOGY	3	-	-

Course Pre-requisite

- Knowledge in Data Structures and algorithm
- Basics of Cryptography

Course Objectives

- To teach the concepts of block chain technologies
- The primary objective of this course is to cover the technical aspects of crypto currencies, block chain Technologies, and distributed consensus
- To familiarize potential applications for Bit coin-like crypto currencies
- The course will enable an individual to learn, how these systems work and how to engineer secure
- To understand the recent trends in Block chain technologies

Course Outcomes

- Understand emerging abstract models for Block Chain Technology
- Analyze the concept of bit coin and mathematical background behind it
- Apply the tools for understanding the background of crypto currencies
- Identify research challenges gaps existing between theory and practice in crypto currency domain
- Applying block chain technologies in recent trends

UNIT I –Introduction: Basic of Block chain Architecture – Challenges – Applications – Block chain Design Principles -The Block chain Ecosystem - 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).

UNIT II – Cryptographic Fundamentals: Cryptographic basics for crypto currency - a short overview of Hashing, cryptographic algorithm – SHA 256, signature schemes, encryption schemes and elliptic curve cryptography- Introduction to Hyper ledger- Hyper ledger framework - Public and Private Ledgers.

UNIT III – Bit Coin: Bit coin - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bit coin. Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their uses.

UNIT IV – Ethereum: Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts. Ethereum and Smart Contracts- The Turing Completeness of Smart Contract Languages and verification challenges- comparing Bitcoin scripting vs. Ethereum Smart Contracts.

UNIT V – Block Chain-Recent Trend: Blockchain Implementation Challenges- Zero Knowledge proofs and protocols in Block chain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves – Zcash - attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - advent of Algor and, and Sharding based consensus algorithms.

TOTAL PERIODS: 60

Text Books

1. Melanie Swan, "Block Chain: Blueprint for a New Economy", O"Reilly, First Edition – 2015.
2. Daniel Drescher, "Block Chain Basics", Apress; 1st Edition, 2017
3. Anshul Kaushik, "Block Chain and Crypto Currencies", Khanna Publishing House, Delhi, 2012
4. Imran Bashir, "Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing, First Edition – 2012.

Reference Books

1. Ritesh Modi, "Solidity Programming Essentials: A Beginner‟s Guide to Build Smart Contracts for Ethereum and Block Chain", Packt Publishing, 2018.

Content Beyond Syllabus

- Smart Contract Application Development
- Apps will be built on block chain technology

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE911	GRAPHICS AND MULTIMEDIA	3	-	-

Course Pre-requisite

- Knowledge in Multimedia
- Knowledge about Image Transformations

Course Objectives

- To gain knowledge about graphics hardware devices and software used
- To the two-dimensional understand graphics and their transformations
- To understand the three-dimensional graphics and their transformations
- To appreciate illumination and color model
- To understand about hyper media and Blender Fundamental

Course Outcomes

- Design two dimensional graphics
- Apply two dimensional transformations
- Design three dimensional graphics
- Apply three dimensional transformations
- Design a graphics using Blender Fundamental

UNIT I – Illumination and Color Models: Light sources - basic illumination models – halftone patterns and dithering techniques; Properties of light - Standard primaries and chromaticity diagram; Intuitive colour concepts - RGB colour model - YIQ colour model - CMY colour model - HSV colour model - HLS colour model; Colour selection. Output primitives – points and lines

UNIT II – Two-Dimensional Graphics: Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.

UNIT III – Three-Dimensional Graphics: Three dimensional concepts; Three dimensional object representations – Polygon surfaces- Polygon tables- Plane equations - Polygon meshes, Spline representations – Bezier curves and surfaces -B-Spline curves and surfaces. **Transformation And Viewing**: Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling. Three dimensional viewing – viewing pipeline, viewing coordinates, Projections

UNIT IV – Multimedia System Design & Multimedia File Handling: Multimedia basics − Multimedia applications − Multimedia system architecture − Defining objects for multimedia systems – Multimedia data interface standards – Multimedia databases. Compression and decompression − Data and file format standards – Multimedia I/O technologies − Digital voice and audio – Video image and animation – Full motion video – Storage and retrieval technologies.

UNIT V – Hypermedia: Multimedia authoring and user interface - Hypermedia messaging - Mobile messaging − Hypermedia message component − Creating hypermedia message − Integrated document management − Distributed multimedia systems. CASE STUDY: BLENDER GRAPHICS Blender Fundamentals – Drawing Basic Shapes – Modeling – Shading & Textures

TOTAL PERIODS: 60

Text Books

1. Donald Hearn and Pauline Baker M, "Computer Graphics", Prentice Hall, New Delhi, 2007 [UNIT I – III].
2. Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. [UNIT IV,V].

Reference Books

1. Judith Jeffcoate, —Multimedia in practice: "Technology and Applications", PHI, 1998.
2. Foley, Vandam, Feiner and Hughes,"Computer Graphics: Principles and Practice", 2nd Edition, Pearson Education, 2003.
3. Jeffrey McConnell, "Computer Graphics: Theory into Practice", Jones and Bartlett Publishers,2006.
4. Hill F S Jr., "Computer Graphics", Maxwell Macmillan, 1990.
5. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, and AK Peters, "Fundamentals of Computer Graphics", CRC Press, 2010.

Content Beyond Syllabus

- Image transformation and classification
- Computer graphics with application

Subject Code	Subject Name	Lectures (Periods)	Tutorials (Periods)	Practical (Periods)
AI OE912	SOCIAL AND ETHICAL ISSUES	3	-	-

Course Pre-requisite

- Knowledge in management and ethical skills
- Basics of management skills

Course Objectives

- To have grounding on theory through the understanding of real life situations and cases
- Analyze ethical dilemmas and articulate a clear, descriptive account prior to forming a normative course of action
- Demonstrate one or more processes of philosophical analysis
- Identify common ethical issues facing professionals in the field of information technology
- Apply ethical concepts and an analytical process to common dilemmas found in the information technology field

Course Outcomes

- To understand ethical issues in workplace and be able to find solution for 'most good'
- An understanding of how computing and information systems give rise to social issues and ethical dilemmas
- An ability to discuss the benefits offered by computing technology in many different areas and the risks and problems associated with these technologies
- An understanding of some social, legal, philosophical, political, constitutional, and economical issues related to computers and the historical background of these issues
- To recognize the need for continuing professional development

UNIT I – Introduction: Definition & nature Business ethics, Characteristics, Ethical theories; Causes of unethical behavior; Ethical abuses; Work ethics; Code of conduct; Public good.

UNIT II – Ethics Theory and Beyond: Management of Ethics - Ethics analysis [Hosmer model]; Ethical dilemma; Ethics in practice - ethics for managers; Role and function of ethical managers- Comparative ethical behavior of managers; Code of ethics; Competitiveness, organizational size, profitability and ethics; Cost of 30 ethics in Corporate ethics evaluation. Business and ecological / environmental issues in the Indian context and case studies.

UNIT III – Legal Aspects of Ethics: Political – legal environment; Provisions of the Indian constitution pertaining to Business; Political setup – major characteristics and their implications for business; Prominent features of MRTP & FERA. Social – cultural environment and their impact on business operations, Salient features of Indian culture and values.

UNIT IV – Environmental Ethics: Economic Environment; Philosophy of economic grow and its implications for business, Main features of Economic Planning with respect to business; Industrial policy and framework of government contract over Business; Role of chamber of commerce and confederation of Indian Industries.

UNIT V – Corporate Social Responsibility and Governance: Definition- Evolution- Need for CSR; Theoretical perspectives; Corporate citizenship; Business practices; Strategies for CSR; Challenges and implementation; Evolution of corporate governance; Governance practices and regulation; Structure and development of boards; Role of capital market and government; Governance ratings; Future of governance- innovative practices; Case studies with lessons learnt.

TOTAL PERIODS: 60

Text Books

1. S.A. Sherlekar, "Ethics in Management", Himalaya Publishing House, 2009.
2. William B. Werther and David B. Chandler, "Strategic corporate social responsibility", Sage Publications Inc., 2011.
3. Robert A.G. Monks and Nell Minow, "Corporate governance", John Wiley and Sons, 2011.

Reference Books

1. W.H. Shaw,"Business Ethics", Cengage Learning, 9th Edition 2017.
2. Beeslory, Michel and Evens, "Corporate Social Responsibility", Taylor and Francis, 1978.
3. Philip Kotler and Nancy Lee, "Corporate social responsibility: doing the most good for company and your cause", Wiley, 2005.
4. Subhabrata Bobby Banerjee, "Corporate social responsibility: the good, the bad and the ugly", Edward Elgar Publishing, 2007.
5. Satheesh kumar, "Corporate governance", Oxford University, Press, 2010.
6. Bob Tricker, "Corporate governance- Principles, policies and practices", Oxford University Press, 2009.
7. Larue Tone Hosmer and Richard D., "The Ethics of Management", Irwin Inc., 1995.
8. Joseph A. Petrick and John F. Quinn, "Management Ethics - integrity at work", Sage, 1997

Content Beyond Syllabus

- Management skills with moral values