



**R23 Course Structure &
Syllabi**

M.Tech. CSE (Artificial Intelligence & Machine Learning)

**Department of Computer Science & Engineering
University College of Engineering Kakinada (A): JNTUK Kakinada**

Academic Regulations (R23) Course Structure & Syllabi

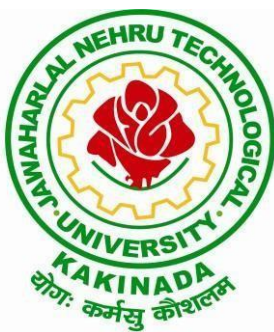
For

Two Year PG Program

in

**M. Tech.
CSE (Artificial Intelligence & Machine Learning)**

(Applicable for batches admitted from A.Y. 2023 - 24)





**R23 Course Structure &
Syllabi**

M.Tech. CSE (Artificial Intelligence & Machine Learning)

**Department of Computer Science & Engineering
University College of Engineering Kakinada (A): JNTUK Kakinada**

UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

(Established by Andhra Pradesh Act No.30 of 2008)

Kakinada – 533 003, Andhra Pradesh (India)

ACADEMIC REGULATIONS R23 FOR M. Tech (REGULAR) DEGREE COURSE

Applicable for the students of M. Tech (Regular) Course from the Academic Year 2023-24 onwards. The M. Tech Degree of Jawaharlal Nehru Technological University Kakinada shall be conferred on candidates who are admitted to the program and who fulfill all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

2.0 AWARD OF M. Tech DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech Degree, if he pursues a course of study in not less than two and not more than four academic years.

2.2 The student shall register for all 68 credits and secure all the 68 credits.

2.3 The minimum instruction days in each semester are 90.

3.0 A. PROGRAMMES OF STUDY

The following specializations are offered by various departments at present for the M. Tech Programme of study.

Department	Programme
Civil Engg.	1. M.Tech- Structural Engineering 2. M. Tech- Soil Mechanics and Foundation Engineering 3. M.Tech-Water Resource Engineering (UA)
EEE	1. M.Tech- High Voltage Engineering 2. M.Tech- Advanced Electrical Power System 3. M.Tech- Power Electronics and Drives



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ME	1. M.Tech- CAD/CAM 2. M.Tech- Machine Design 3. M.Tech-Thermal Engineering
ECE	1. M.Tech- Computer and Communication 2. M.Tech- VLSI and Embedded Systems 3. M.Tech- Instrumentation and Control Engineering (UA)
CSE	1. M.Tech- Computer Science and Engineering 2. M.Tech- Artificial Intelligence and Machine Learning 3. M.Tech-Cyber Security

4.0 ATTENDANCE

- 4.1 The faculty handling the course will finalise the attendance as per schedule / before the last instructional day of the course and submit to the Principal through the head of the department.
- 4.2 A student with less than 75% of consolidated attendance (and/or less than 50% in each **and every course**), **will not be permitted to** appear for the end- semester examinations, irrespective of the reason for the shortfall of the attendance. Further, a **student with less than 75% of attendance in Dissertation Phase-2 (IV Semester) will not be permitted to submit his project work.**
- 4.3 The student is however permitted to avail Academic/Medical Leave/ NCC / NSS / Cultural / Sports/ Minor Medical exigencies etc., up to 10% for attending academic related activities like, Industrial Visits, Seminars, Conferences, Competitions etc., with the prior approval of the HoD. After the event, the student should submit the relevant documents for proof to the HoD for approval of the Academic Leave.
- 4.4 **Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%, and minimum of 50% in each and every course including laboratory, Dissertation phase-1, Dissertation Phase-2) for a maximum of **ONE time** shall be granted by the College Academic Committee. A prescribed fee shall be payable towards condonation of shortage of attendance.**
- 4.5 Shortage of Attendance below 65% in aggregate shall not be condoned and not eligible to write their end semester examination of that class.
- 4.6 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next.
- 4.7 If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.



5.0 EVALUATION

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practical's, on the basis of Internal Evaluation and End Semester Examination.

- 5.1 For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. The weightage of Internal marks for 40 consists of Descriptive – 32 and Assignment – 08 (open book exam). Descriptive exam shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 8 marks. The descriptive examination conducted for 32 marks are to be added to the assignment 8 marks for finalizing internal marks for 40. The internal evaluation shall be made based on the average of the marks secured in the two Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Semester End Exam Paper containing FIVE mandatory questions (one question from one unit) with internal choice, each carrying 12 marks gives for 60marks.
- 5.2 For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded as internal marks, based on the day to day work-10 marks, Record-10 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with a breakup marks of Procedure-15, Experimentation-25, Results-10 ,Viva-voce-10.
- 5.3 For **Mini Project with seminar**, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For Mini Project with seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. Out of 100 marks, supervisor awards 40% marks and remaining 60% marks are awarded by the project review committee.
- 5.4 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together. For integrated courses, student should secure the minimum



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academic requirements in both theory and practical together.

- 5.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to reappear for the End semester Examination in that subject. A candidate shall be given a chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and has failed in the end examination. In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt stand cancelled. For re-registration the candidates have to apply to the college by paying the requisite fees before the start of the semester in which re-registration is required.
- 5.6 In case the candidate secures less than the required attendance in any re registered subject (s), he shall not be permitted to write the End Examination in that subject. He shall again re-register the subject when next offered.
- 5.7 Laboratory examination for M. Tech. programmes must be conducted with two Examiners, one of them being the Laboratory Class Teacher or teacher from the same department and the second examiner shall be appointed by the Principal from the panel of examiners submitted by the respective HoD.
- 5.8 Student is allowed to register for 12 week SWAYAM / NPTEL MOOC courses (recommended by HoD/BoS) and can obtain required credits during II Semester itself. In any case, if a student fails in obtaining credits, he is allowed to repeat the initially opted course / change to another MOOC course or regular course and will be considered as regular candidate only. After successful completion, by end of III/IV Semester, he needs to submit the course certificate (through HoD) to the exam section to perform credit transfer. In addition to credit courses, for completing the programme and obtaining degree, a student needs to complete audit courses. Audit courses will be conducted, evaluated as normal credit courses, and the assessment will be graded as Pass/Fail.
- 5.9 Students shall undergo mandatory summer internships (2 credits) for a minimum of eight weeks duration at the end of second semester of the Programme/Summer Break. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the committee. The Committee comprises of Head of the Department and two faculty. The report and the oral presentation shall carry 40% and 60% weightages respectively. For internship, there will be only



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internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

6.0 EVALUATION OF PROJECT/DISSERTATION (Phase-I and II):

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

- 6.1 A Project Review Committee (PRC) shall be constituted with Head of the Department and two other senior faculty members in the department.
- 6.2 Registration of Dissertation / Project Work: The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters.
- 6.3 A candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work (published base paper(s) / real time project / industry oriented) for approval. The student can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).
- 6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Project Review Committee (PRC). However, the Project Review Committee (PRC) shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.
- 6.5 A candidate shall present seminar on his project work status in two stages at least with a gap of THREE months between them. If the candidate is absent to any seminar, he should again attend to seminar within two weeks by providing proper evidence to the Project Review Committee for earlier absence to the seminar.**
- 6.6 A candidate is permitted to submit Project Thesis (Dissertation) only after successful completion of theory and practical course **with the approval of PRC** not earlier than 40 weeks from the date of registration of the project work.
- 6.7 Continuous assessment of Dissertation-I and Dissertation-II during the Semester will be monitored by the PRC.
- 6.8 There will be pre-submission seminar at the end of academic term. **After the approval the student has to submit the detail report.**
- 6.9 The Candidate may be permitted to submit the Project Report If only the work is Published/Accepted to be Published in a National or International Journal / conference of reputed and relevance.**



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- 6.10 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College along with plagiarism report (<40%).
- 6.11 The thesis shall be adjudicated by one examiner selected by the Principal, from the panel of 5 examiners, eminent in that field, submitted by the guide concerned and head of the department.
- 6.12 If the report of the examiner is not favorable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the Principal.
- 6.13 If the report of the examiner is favorable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor/Internal examiner, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work for a maximum of 100 Marks. **Out of 100 marks, supervisor awards 40 marks and remaining 60 marks are awarded by the board.**
- 6.14 The Head of the Department shall coordinate and make arrangements for the conduct of Viva-Voce examination.
- 6.15 If the report of the Viva-Voce is unsatisfactory (i.e., <50 marks), the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, the candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the Institution.

7.0 Cumulative Grade Point Average (CGPA)

Marks Range (Max – 100)	Letter Grade	Level (G)	Grade Point
≥ 90	>90	Outstanding (O)	10
≥80 to <90	90-80	Excellent (S)	9
≥70 to <80	80-70	Very Good (A)	8
≥60 to <70	70-60	Good (B)	7
≥50 to <60	60-50	Fair (C)	6
<50	<50	Fail (F)	0
		Absent	0

Computation of SGPA

The following procedure is to be adopted to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The **SGPA** is the ratio of sum of the product of the number of credits



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with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e **SGPA (Si) = $\sum (Ci \times Gi) / \sum Ci$**

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Computation of CGPA

The **CGPA** is also calculated in the same manner taking into account all the courses undergone by a student over all the semester of a programme, i.e. **CGPA = $\sum (Ci \times Si) / \sum Ci$**

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester. The SGPA and CGPA shall be rounded off to TWO decimal points and reported in the transcripts.

8.0 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, or if any case of indiscipline is pending against him, the result of the student will be withheld. His degree will be withheld in such cases.

9.0 TRANSITORY REGULATIONS

9.1 Discontinued or detained candidates are eligible for re-admission into same orequivalent subjects at a time as and when offered.

10. GENERAL

- 10.1 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.
- 10.2 The academic regulation should be read as a whole for the purpose of any interpretation.
- 10.3 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
- 10.4 The College may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the College.



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MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/ Improper conduct	Punishment
	<i>If the candidate:</i>	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and Cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year.



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3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practical and project work) already appeared and shall not be allowed to appear for Examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all External examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all External examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.



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6.	Refuses to obey the orders of the Chief Superintendent/Assistant-Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all External examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.



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8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	<p>Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.</p> <p>Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.</p>
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester /year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	



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**Examination Branch
Appointment of Subject Expert for QP Setting**

**From
Dr U V Ratna Kumari
Vice-Principal**

Date: 01.10.2023.

To

I am advised to inform you that you are appointed as subject expert to set the question paper(s) as per the details noted below. You are requested to set the question paper(s) in MS word document format and send a soft copy oiel.ucek@jntucek.ac.in. The hard copies of the question paper(s) shall be sent along with the remuneration bill.

You are requested to set the Question Paper(s) by following OBE pattern, as per the revised Bloom's Taxonomy herewith enclosed. Keep this appointment strictly confidential.

1. You are requested to prepare a balanced question paper within the prescribed syllabus covering the entire syllabus. The duration of the examination is **3-hours** and you are requested to prepare the questions in such a way that student must be able to answer each question for about 35-45 minutes time.
2. It is informed that the question paper covering the topics of all FIVE units for 60 marks. Also the question paper shall be set as per the format enclosed, containing ten main questions (two from each unit) over FIVE-units of syllabus with internal choice and **12marks** for each question. The main question shall contain sub questions like 1(a), 1(b) etc.
3. The student has to answer FIVE mandatory questions (One question from one unit).
4. The requirement of data books, codes, graphs etc. may please be indicated on the question paper.
5. You are requested to give the distribution of the marks for each question.
- 6. You are requested not to reproduce questions from previous question papers.**
7. Remuneration for setting of one question paper for M.Tech(PG) programme is **Rs. 1,200/-** per set.
8. You are requested to confirm your acceptance through e-mail.

You are requested to reject the offer and intimate the same to the Vice Principal, if any of your relatives are writing the examination or if you are involved in any extra assignment in any tutorial/coaching centers. Please send the question paper in the enclosed model (model is attached for reference).

Question Paper Details		R19 OBE Pattern			
Course	M.Tech (PG)	Question No.	Unit/CO's	Bloom's Taxonomy Level	Marks
Name of the Examination	I-M.Tech, I-Sem (R23) Regular End Exams, Dec-2023	I	U1/CO1	L2/L3/L4	12
Subjects	XXXXXXX	II	U2/CO2	L2/L3/L4	12
Branch	XXXXXXXXXX	III	U3/CO3	L2/L3/L4	12
No of Question Paper Sets	1 (Ono)	IV	U4/CO4	L2/L3/L4	12
Last Date for submission	14/11/2023	V	U5/CO5	L2/L3/L4	12

Note: U1: Unit 1, CO1: Course Outcome 1

L1: Level 1(Bloom's Cognitive Level) L2: Understanding Level; L3: Apply Level; L4: Analyze Level.

VICE-PRINCIPAL



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Course Code:

R23

**University College of Engineering Kakinada (Autonomous)
Jawaharlal Nehru Technological University Kakinada**

() B. Tech. () Semester (R23) Regular Examinations, ()

**COURSE NAME
(NAME OF BRACH)**

Time: 3 hrs.

Max Marks: 60

Answer all five questions

5X12=60

Q.No	Question	Marks	CO	BL
UNIT-1				
1(a)				
1(b)				
(OR)				
2(a)				
2(b)				
UNIT-2				
3(a)				
3(b)				
(OR)				
4(a)				
4(b)				
UNIT-3				
5(a)				
5(b)				
(OR)				
6(a)				
6(b)				
UNIT-4				



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7(a)				
7(b)				
(OR)				
8(a)				
8(b)				
UNIT-5				
9(a)				
9(b)				
(OR)				
10(a)				
10(b)				

Note: CO: Course Outcome, BL: Bloom's Cognitive Level;



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REVISED Bloom's Taxonomy Action Verbs

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	<ul style="list-style-type: none"> Choose Define Find How Label List Match Name Omit Recall Relate Select Show Spell Tell What When Where Which Who Why 	<ul style="list-style-type: none"> Classify Compare Contrast Demonstrate Explain Extend Illustrate Infer Interpret Outline Relate Rephrase Show Summarize Translate 	<ul style="list-style-type: none"> Apply Build Choose Construct Develop Experiment with Identify Interview Make use of Model Organize Plan Select Solve Utilize 	<ul style="list-style-type: none"> Analyze Assume Categorize Classify Compare Conclusion Contrast Discover Dissect Distinguish Divide Examine Function Inference Inspect List Motive Relationships Simplify Survey Take part in Test for Theme 	<ul style="list-style-type: none"> Agree Appraise Assess Award Choose Compare Conclude Criteria Criticize Decide Deduct Defend Determine Disprove Estimate Evaluate Explain Importance Influence Interpret Judge Justify Mark Measure Opinion Perceive Prioritize Prove Rate Recommend Rule on Select Support Value 	<ul style="list-style-type: none"> Adapt Build Change Choose Combine Compile Compose Construct Create Delete Design Develop Discuss Elaborate Estimate Formulate Happen Imagine Improve Invent Make up Maximize Minimize Modify Original Originate Plan Predict Propose Solution Solve Suppose Test Theory



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I-SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	R23MAM1101	Program Core-1 Mathematics for ML	PC	3	0	0	3
2	R23MAM1102	Program Core-2 (Integrated Course-Theory & Laboratory Course) Artificial Intelligence	PC	3	0	3	4.5
3	R23MAM1103	Program Elective-1 1. Advanced Data Mining 2. Mining Massive Data Sets 3. High Performance Computing	PE	3	0	0	3
4	R23MAM1104	Program Elective-2 1. Augmented Reality and Virtual Reality 2. Recommender Systems 3. Time Series Analysis	PE	3	0	0	3
5	R23MAM1105	Research Methodology and IPR	CC	2	0	0	2
6	R23MAM1106	Laboratory-1 Data Wrangling Lab	LB	0	0	3	1.5
7	R23MAM1107	Audit Course-1* 1. English for Research Paper Writing 2. Disaster Management 3. Sanskrit for Technical Knowledge 4. Value Education	AC	2	0	0	0
Total Credits							17

**Student has to choose any one audit course listed.*



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II SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	R23MAM1201	Program Core-3(Integrated Course-Theory & Laboratory Course) Machine Learning	PC	3	0	3	4.5
2	R23MAM1202	Program Core-4 Deep Learning	PC	3	0	0	3
3	R23MAM1203	Program Elective-3 1. Computer Vision 2. Quantum Computing 3. Soft computing	PE	3	0	0	3
4	R23MAM1204	Program Elective-4 1. Robotics and Intelligent Systems 2. Reinforcement Learning 3. Generative AI	PE	3	0	0	3
5	R23MAM1205	Laboratory-4 Deep Learning Lab	LB	0	0	3	1.5
6	R23MAM1206	Mini Project with Seminar	MP	2	0	0	2
7	R23MAM1207	Audit Course-2 * 1. Constitution of India 2. Pedagogy Studies 3. Stress Management by Yoga 4. Personality Development through Life Enlightenment Skills	AC	2	0	0	0
Total Credits							17

**Student has to choose any one audit course listed..*



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III-SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	R23MAM2101	Program Elective-5 Natural Language Processing with Deep Learning / MOOCs-1 (NPTEL/ SWAYAM) 12 Week Program related to the program which is not listed in the course structure (PG Level)	PE	3	0	0	3
2	R23MAM2102	Open Elective 1. MOOCs-2 (NPTEL/SWAYAM)-Any 12 Week Course on Engineering/ Management/ Mathematics offered by other than parent department 2. Course offered by other departments in the college	OE	3	0	0	3
3	R23MAM2103	Internship (During II Sem to III Sem / Summer break in I Year - TWO months internship)					2
4	R23MAM2104	Dissertation-I/ Industrial Project #	PJ	0	0	20	10
Total Credits							18

Students going for Industrial Project/ Thesis will complete these courses through MOOCs

IV SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	R23MAM2201	Dissertation-II	PJ	0	0	32	16
Total Credits							16



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I Year - I Semester	MATHEMATICS FOR ML (R23MAM1101)	L	T	P	C
		3	0	0	3

Course Objectives:

The main objective of the course is to provide a deep understanding of the math that makes machine learning algorithms work.

Course Outcomes:

At the end of the course the student should be able to

- Understand concepts in abstract algebra and algebraic structures
- Utilise eigen values and matrix factorisation techniques in practical problems
- Comprehend vectors and vector spaces
- Use Probability, Bayes theorem and random variables in applications

UNIT-I

Linear Algebra: Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces

UNIT-II

Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations

UNIT-III

Matrix Decompositions: Determinant and Trace, Eigen values and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Matrix Phylogeny

UNIT-IV

Vector Calculus : Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series

UNIT-V

Probability and Distributions: Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform

Continuous Optimization: Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization

Text Books:



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1. “Mathematics for Machine Learning”, Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Cambridge University Press.
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2017.

Reference Books:

1. Machine Learning: An Applied Mathematics Introduction, Paul Wilmott, Panda Ohana Publishing 2019.



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I Year - I Semester	ARTIFICIAL INTELLIGENCE (R23MAM1102)	L	T	P	C
		3	0	3	4.5

Course Objectives:

- Gain a historical perspective of Artificial Intelligence (AI) and its foundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
- Experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool. Experiment with a machine learning model for simulation and analysis.
- Explore the current scope, potential, limitations, and implications of intelligent systems.

Course Outcomes (COs): At the end of the course, student will be able to

- Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
- Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
- Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.
- Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.
- Solve problems with uncertain information using Bayesian approaches.

UNIT-I:

Introduction to artificial intelligence: Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, development of AI languages, current trends in AI, **Problem solving: state-space search and control strategies:** Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative-deepening A*, constraint satisfaction

UNIT-II:

Problem reduction and game playing: Introduction, problem reduction, game playing, alpha-beta pruning, two-player perfect information games, **Logic concepts:** Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in propositional logic, resolution refutation in propositional logic, predicate logic

UNIT-III:

Knowledge representation: Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended



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semantic networks for KR, knowledge representation using frames, **advanced knowledge representation techniques:** Introduction, conceptual dependency theory, script structure, cyc theory, case grammars, semantic web.

UNIT-IV:

Uncertainty measure: probability theory: Introduction, probability theory, Bayesian belief networks(exact and approximate inference) certainty factor theory, dempster-shafer theory , non-monotonic reasoning, TMS.

UNIT-V:

Expert systems:- Introduction, basic concepts, structure of expert systems, the human element in expertsystems how expert systems works, problem areas addressed by expert systems, expert systems successfactors, types of expert systems, expert systems and the internet interacts web, knowledge engineering,scope of knowledge, difficulties, in knowledge acquisition methods of knowledge acquisition, machinelearning, intelligent agents, selecting an appropriate knowledge acquisition method, societal impactsreasoning in artificial intelligence, inference with rules, with frames: model based reasoning, case basedreasoning, explanation & meta knowledge inference with uncertainty representing uncertainty.

List of Experiments:

1. Implementation of DFS for water jug problem using PYTHON
2. Implementation of BFS for tic-tac-toe problem using PYTHON
3. Implementation of TSP using heuristic approach using PYTHON
4. Implementation of Simulated Annealing Algorithm using PYTHON
5. Implementation of Hill-climbing to solve 8- Puzzle Problem using PYTHON
6. Implementation of Monkey Banana Problem using PYTHON
7. Implementation of A* Algorithm using PYTHON
8. Implementation of AO* Algorithm using PYTHON
- 9.Implementation of Min-Max Game playing algorithm using PYTHON
10. Implementation Expert System with forward chaining using PYTHON
11. Implementation Expert System with backward chaining using PYTHON

Text Books:

1. Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, Prentice Hall
2. Artificial Intelligence, SarojKaushik, 1st Edition, CENGAGE Learning, 2011.

Reference Books:

1. Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar, PEA
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017
3. Artificial Intelligence, A new Synthesis, 1st Edition, Nils J Nilsson, Elsevier, 1998



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4. Artificial Intelligence- 3rd Edition, Rich, Kevin Knight, Shiv Shankar B Nair, TMH
5. Introduction To Artificial Intelligence And Expert Systems, 1st Edition, Patterson, Pearson India, 2015



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I Year - I Semester	ADVANCED DATA MINING (R23MAM1103)	L	T	P	C
		3	0	0	3

Course Objectives:

The main objective of the course is to understand the fundamentals of data mining and its functionalities and realize the issues regarding clustering, classification and prediction

Course Outcomes:

After the completion of the course, student will be able to:

- **Compare** types of data, quality of data, suitable measures required to perform data analysis. (UNIT-I) - **K2**
- **Choose** appropriate classification technique to perform classification, model building and evaluation (UNIT-II)- **K3**
- **Make use of** association rule mining techniques on categorical and continuous data (UNIT III) - **K3**
- **Identify and apply** clustering algorithm (with open source tools), interpret, evaluate and report the result (UNIT IV) - **K3**
- **Analyze and Compare** anomaly detection techniques (UNIT-V) - **K4**

UNIT I: Data Mining Methodologies: CRISP-DM and SEMMA, Comparison of Data Mining Methodologies. Statistical Limits on Data Mining, Introduction to Predictive Analytics, **Classification & Prediction:** Predictive Modelling; Concepts, General Approach to solving a classification problem, - ZeroR, OneR, Decision Tree Induction: Attribute Selection Measures, Tree Pruning, Scalability and Decision Tree Induction, Bayesian Classification Methods: Bayes Theorem, Naïve Bayes Classification, Model Evaluation and Selection, Visualization techniques and experiments with weka.

UNIT II: Association Analysis: Problem Definition, Frequent Itemset Generation, Rule Generation: Confident Based Pruning, Rule Generation in Apriori Algorithm, Compact Representation of frequent item sets, FP-Growth Algorithm, Generating item sets and rules efficiently, Covariance and Correlation analysis.

UNIT III: Advanced Concepts on Association Analysis: Handling Categorical and Continuous Attributes, Handling a Concept Hierarchy, Sequential Patterns: Preliminaries, Sequential Pattern Discovery, Timing Constraints, Alternative Counting Schemes; Subgraph Patterns: Preliminaries: Frequent Subgraph Mining, Candidate Generation, Candidate Pruning, Support Counting (Tan & Vipin Kumar)

UNIT IV: Clustering: Importance of Cluster Analysis, Clustering techniques, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. (Tan & Vipin Kumar)



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UNIT V: Cluster Analysis - Additional Issues and Algorithms: Cluster Evaluation, Characteristics of Data, Clusters, and Clustering Algorithms. (Tan & Vipin Kumar)

Mining rich data types: Mining text data, Spatial-temporal data, Graph and networks (Han 4th ed)

Mining real data: preprocessing data from a real medical domain, data mining techniques to create a comprehensive and accurate model of data.

Text Books:

1. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, 2nd edition
2. Data Mining: Concepts and Techniques, J. Han and M. Kamber, Morgan Kaufmann C.J. Date, Database Systems, Pearson, 4th edition

Reference Books:

1. Fundamentals of Data Warehouses, 2nd edition, Jarke, Lenzerini, Vassiliou, Vassiliadis, Springer.

Suggested NPTEL Course and other Useful Websites:

1. <https://nptel.ac.in/courses/106105174/>
2. <http://cse20-iiith.vlabs.ac.in/>



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I Year - I Semester	MINING MASSIVE DATA SETS (R23MAM1103)	L	T	P	C
		3	0	0	3

Course Objectives:

Course Outcomes:

Upon Successful completion of course, the student will be able to

1. Recollecting fundamentals of data mining- L2
2. Apply the concept of Map reduce and data streams for storing and processing of massive data sets - L3
3. Analyze the issues underlying the effective applications of massive data sets - L4
4. Evaluate different clustering algorithms and analyze various decomposition techniques - L4

Unit I:

Data Mining: Introduction, Statistical Modeling, Machine Learning, Computational Approaches to Modeling, Feature Extraction, Statistical Limits on Data Mining, Hash Functions, Indexes, Natural Logarithms, Power Laws. (CO 1)

Unit II:

Map Reduce and the New Software Stack: Distributed File Systems, Map Reduce, Algorithms Using MapReduce, Extensions to MapReduce, Complexity Theory for MapReduce (CO 2)

Unit III:

Mining Data Streams: The Stream Data Model, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Counting Ones in a Window, Decaying Windows. (CO 1, CO 2)

Unit IV:

Frequent Item sets: The Market-Basket Model, Market Baskets and the A-Priori Algorithm, Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream. (CO 1, CO 3)

Unit V:

Clustering: Introduction to Clustering Techniques, Hierarchical Clustering, K-means Algorithms, The CURE Algorithm, Clustering in Non-Euclidean Spaces, and Clustering for Streams and Parallelism.

Dimensionality Reduction: Eigen values and Eigenvectors of Symmetric Matrices, Principal-Component Analysis, Singular-Value Decomposition, CUR Decomposition (CO 1, CO 4).



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Text Books:

1. Mining of Massive Datasets - Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman



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I Year - I Semester	HIGH PERFORMANCE COMPUTING (R23MAM1103)	L	T	P	C
		3	0	0	3

Course Objectives:

The main objectives of the course is to study parallel computing hardware and programming models, performance analysis and modeling of parallel programs

Course Outcomes:

On completion of the course, student will be able to–

- Describe different parallel architectures, inter-connect networks, programming models
- Develop an efficient parallel algorithm to solve given problem
- Analyze and measure performance of modern parallel computing systems
- Build the logic to parallelize the programming task

Unit I -Introduction:

Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi-core architecture.

Unit II -Parallel Programming:

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.

Unit III -Basic Communication:

Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

Programming shared address space platforms: threads- basics, synchronization, OpenMP programming

Unit IV :

Analytical Models: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and The effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. Dense Matrix Algorithms: MatrixVector Multiplication, Matrix-Matrix Multiplication.



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Unit V :

Parallel Algorithms- Sorting and Graph : Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel BestFirst Search.

CUDA Architecture : CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, Parallel programming in CUDA- C.

Text Books:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Jason sanders, Edward Kandrot, "CUDA by Example", Addison-Wesley, ISBN-13: 978-0-13-138768-3

Reference Books:

1. Kai Hwang, "Scalable Parallel Computing", McGraw Hill 1998, ISBN:0070317984
2. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884
3. David Culler Jaswinder Pal Singh, "Parallel Computer Architecture: A Hardware/ Software Approach", Morgan Kaufmann,1999, ISBN 978-1-55860-343-1
4. Rod Stephens, "Essential Algorithms", Wiley, ISBN: ISBN: 978-1-118-61210-1



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I Year - I Semester	AUGMENTED REALITY AND VIRTUAL REALITY (R23MAM1104)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To acquire the knowledge on augmented reality
2. To demonstrate the augmented reality devices.
3. To acquire the knowledge on virtual reality.
4. To illustrate the VR devices.
5. To explain how to apply VR/AR for various applications

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

1. Summarize about augmented reality.
2. Choose AR devices for various applications.
3. Summarize about augmented reality.
4. Experiment with VR devices.
5. Apply AR & VR technology in various domains.

UNIT I :

Augmented Reality, origin of Augmented Reality, The Relationship Between Augmented Reality and Other Technologies, Augmented Reality Concepts, working of Augmented Reality, Ingredients of an Augmented Reality Experience.

UNIT II :

Augmented Reality Hardware, Major Hardware Components for Augmented Reality Systems, Augmented Reality Software, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

UNIT III :

Virtual Reality: The Three I's of Virtual Reality, A Short History of Early Virtual Reality, Early Commercial VR Technology , VR Becomes an Industry, The Five Classic Components of a VR System.

Input Devices: Trackers, Navigation, and Gesture Interfaces: Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces

UNIT IV :

Output Devices: Graphics, Three-Dimensional Sound, and Haptic Displays :Graphics Displays, Sound Displays, Haptic Feedback.

Human Factors in VR: Methodology and Terminology, User Performance Studies, VR Health and Safety Issues, VR and Society

UNIT V :

Augmented Reality Applications, characteristics of a Good Augmented Reality Application, Application Areas, Magic Books, Magic Windows and Doors, Applying Augmented Reality to a Problem, Evaluating Augmented Reality Applications, VR Applications in Manufacturing, Applications of VR in Robotics.



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Text Books:

1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
2. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.

Reference Books:

1. LaValle, "Virtual Reality", Cambridge University Press, 2016.
2. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
3. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.
4. Anand R., "Augmented and Virtual Reality", Khanna Publishing House, Delhi.



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I Year - I Semester	RECOMMENDER SYSTEMS (R23MAM1104)	L	T	P	C
		3	0	0	3

Course Objectives:

This course covers the basic concepts of recommender systems, including personalization algorithms, evaluation tools, and user experiences

Course Outcomes:

- Describe basic concepts behind recommender systems
- Explain a variety of approaches for building recommender systems
- Describe system evaluation methods from both algorithmic and users' perspectives
- Describe applications of recommender systems in various domains

UNIT-I:

Introduction: Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

UNIT-II:

Collaborative Filtering: User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems.

UNIT-III:

Content-based recommendation: High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.

UNIT-IV:

Hybrid approaches: Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies.

UNIT-V:

Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centred metrics.

Recommender Systems and communities: Communities, collaboration and recommender systems in personalized web search, Social tagging recommender



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systems, Trust and recommendations

Text Books:

1. Jannach D., Zanker M. and Felfering A., Recommender Systems: An Introduction, Cambridge University Press(2011), 1st ed.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.

Reference Books:

1. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.



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I Year - I Semester	TIME SERIES ANALYSIS (R23MAM1104)	L	T	P	C
		3	0	0	3

Course Objectives: The main objective of the course is to introduce a variety of statistical models for time series and cover the main methods for analyzing these models

Course Outcomes:

At the end of the course, the student should be able to

- formulate real life problems using time series models
- use statistical software to estimate the models from real data, and draw conclusions and develop solutions from the estimated models.
- use visual and numerical diagnostics to assess the soundness of their models
- communicate the statistical analyses of substantial data sets through explanatory text, tables and graphs
- combine and adapt different statistical models to analyze larger and more complex data

Unit I:

INTRODUCTION OF TIMESERIES ANALYSIS: Introduction to Time Series and Forecasting, Different types of data, Internal structures of time series. Models for time series analysis, Autocorrelation and Partial autocorrelation. Examples of Time series Nature and uses of forecasting, Forecasting Process, Data for forecasting, Resources for forecasting

Unit II:

STATISTICS BACKGROUND FOR FORECASTING: Graphical Displays, Time Series Plots, Plotting Smoothed Data, Numerical Description of Time Series Data, Use of Data Transformations and Adjustments, General Approach to Time Series Modeling and Forecasting, Evaluating and Monitoring Forecasting Model Performance.

Unit III:

TIME SERIES REGRESSION MODEL: Introduction Least Squares Estimation in Linear Regression Models, Statistical Inference in Linear Regression, Prediction of New Observations, Model Adequacy Checking, Variable Selection Methods in Regression, Generalized and Weighted Least Squares, Regression Models for General Time Series Data, Exponential Smoothing, First order and Second order

Unit IV:

AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) MODELS: Autoregressive Moving Average (ARMA) Models, Stationarity and Invertibility of ARMA Models, Checking for Stationarity using Variogram, Detecting Nonstationarity, Autoregressive Integrated Moving Average (ARIMA) Models, Forecasting using ARIMA, Seasonal Data, Seasonal ARIMA Models Forecasting using Seasonal ARIMA Models Introduction, Finding the "BEST" Model.

Example: Internet Users Data Model Selection Criteria, Impulse Response Function to Study the Differences in Models Comparing Impulse Response Functions for



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Competing Models .

Unit V:

MULTIVARIATE TIME SERIES MODELS AND FORECASTING: Multivariate Time Series Models and Forecasting, Multivariate Stationary Process, Vector ARIMA Models, Vector AR (VAR) Models, Neural Networks and Forecasting Spectral Analysis, Bayesian Methods in Forecasting.

Text Books:

1. Introduction To Time Series Analysis And Forecasting, 2nd Edition, Wiley Series In Probability And Statistics, By Douglas C. Montgomery, Cheryl L. Jen(2015)
2. Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek PalDr. PksPrakash (2017)



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I Year - I Semester	RESEARCH METHODOLOGY AND IPR (R23MAM1105)	L	T	P	C
		2	0	0	2

Course Objectives:

- Student able analyze the Effective literature studies approaches, analysis, Plagiarism, Research ethics.
- Student should able understand problem, Scope and objectives of research problem.
- To learn and understand Traditional knowledge Case Studies, IPR and IITs

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

Course Outcomes		Knowledge Level (K)#
CO1	Demonstrate the research and its types, Reviewing literature. Identifying and defining research problem.	K2
CO2	Explaining research design methods, sampling techniques	K5
CO3	Designing and development of measuring instruments, data collection and analysis methods	K6
CO4	Show the IPR protection provides an incentive to inventors for further research work and Investment in R & D, which leads to creation of new and better products, and in turn brings about, Economic growth and social benefits.	K1
CO5	Identify Research proposal, research report and evaluating research	K3

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II: Effective literature studies approaches, analysis, Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee



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UNIT-III: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT

UNIT-IV: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications

UNIT-V: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Book:

1. Research methodology: an introduction for science & engineering students, 1st Edition, [Stuart Melville](#), [Wayne Goddard](#), 1996

Reference Books:

1. Research Methodology: A Step by Step Guide for beginners, 2nd Edition, Ranjit Kumar, 2011
2. Resisting Intellectual Property, 1st Edition, Halbert, Taylor & Francis Ltd., 2007



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I Year - I Semester	DATA WRANGLING LAB (R23MAM1106)	L	T	P	C
		0	0	3	1.5

Course Objectives:

Course Outcomes:

Student should be able to

- Perform Read and write operations on CSV,JSON and XML files
- Process the Excel file using Pandas
- Parse and Extract the Tables using Python library
- Apply the basis of Data cleanup operation on the given dataset
- Explore the web scraping in Python

List of Experiments:

1. Write a Python script to read each row from a given csv file and print a list of strings.
2. Write a Python program to read a given CSV file as a dictionary.
3. Write a Python program to convert Python dictionary object (sort by key) to JSON data. Print the object members with indent level 4
4. Write the python script to Read the XML file
5. Write a Pandas program to import excel data (child labour and child marriage data.xlsx) into a Pandas data frame and process the following
 - a. Get the data types of the given excel data
 - b. Display the last ten rows.
 - c. Insert a column in the sixth position of the said excel sheet and fill it with NaN values
6. Develop the python script to parse the pdf files using pdfminer.
7. Extract the Table from the child labour and child marriage data.xlsx using pdfables library
8. Write a Python data wrangling scripts to insert the data into SQLite database
9. Develop the Python Shell Script to do the basic data cleanup on child labour and child marriedata.xlsx
 - a. Check duplicates and missing data
 - b. Eliminate Mismatches
 - c. Cleans line breaks, spaces, and special characters
10. Import the data into `agate` then explores the table using agate methods and perform statistical correlations
11. Draw the chart between perceived corruption scores compared to the child labour percentages using matplotlib.
12. Write the python script to Map the Child Labour Worldwide using pygal.



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Text Books:

1. Jacqueline Kazil& Katharine Jarmul,” Data Wrangling with Python”, O’Reilly Media, Inc,2016
2. Dr. TirthajyotiSarkar, Shubhadeep,” Data Wrangling with Python: Creating actionable data from raw sources”, Packt Publishing Ltd,2019.



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I Year - I Semester	ENGLISH FOR RESEARCH PAPER WRITING (R23MAM1107)	L	T	P	C
		2	0	0	0

Course Objectives:

- Understand that how to improve your writing skills and level of Readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

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

Course Outcomes		Knowledge Level (K)#
CO1	How to improve your writing skills and level of readability	K1
CO2	Explain about what to write in each section	K3
CO3	Classify the skills needed when writing a Title	K2

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts Introduction

UNIT-III: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

UNIT-V: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT-VI: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.



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Text Books:

1. Writing for Science, 0th Edition, Yale University Press, Goldbort R 2006
2. How to Write and Publish a Scientific Paper, 7th Edition, Cambridge University Press, Day R 2006
3. Handbook of Writing for the Mathematical Sciences, 2nd Edition, SIAM, Highman's book, Highman N 1998



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I Year - I Semester	DISASTER MANAGEMENT (R23MAM1107)	L	T	P	C
		2	0	0	0

Course Objectives:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

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

Course Outcomes		Knowledge Level (K)#
CO1	Demonstrate the critical understanding of key concepts in disaster risk reduction and humanitarian response.	K2
CO2	Evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.	K5
CO3	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.	K6
CO4	Analyze the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in	K4
CO5	Describe disaster risk reduction and humanitarian response. Outline the disaster risk reduction and humanitarian response policy and practice from multiple perspectives.	K2,K3

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I: Introduction- Disaster- Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT-II: Repercussions of Disasters And Hazards- Economic Damage, Loss of



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Human and Animal Life, Destruction of Ecosystem. Natural Disasters- Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III: Disaster Prone Areas In India- Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches, Areas Prone to Cyclonic and Coastal Hazards With Special Reference to Tsunami, Post-Disaster Diseases and Epidemics

UNIT-IV: Disaster Preparedness And Management- Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-V: Risk Assessment- Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival.

Disaster Mitigation- Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation, Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text Books:

1. Disaster Management in India: Perspectives, issues and strategies, R. Nishith, Singh AK, New Royal book Company
2. Disaster Mitigation Experiences and Reflections, Sahni, New Title Edition , Pardeep Et. Al. (Eds.), Prentice Hall Of India, New Delhi
3. Disaster Administration and Management Text and Case Studies, 1st Edition, Deep & Deep Publication Pvt. Ltd., Goel S. L., New Delhi



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I Year - I Semester	SANSKRIT FOR TECHNICAL KNOWLEDGE (R23MAM1107)	L	T	P	C
		2	0	0	0

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects
- enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the
- Huge knowledge from ancient literature

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

Course Outcomes		Knowledge Level (K)#
CO1	Demonstrate basic Sanskrit language	K2
CO2	Illustrate Ancient Sanskrit literature about science & technology	K2
CO3	Build a logical language will help to develop logic in students	K6

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I: Alphabets in Sanskrit, Past/Present/Future Tense.

UNIT-II: Simple Sentences forming in Sanskrit.

UNIT-III: Order of Sanskrit sentences, Introduction of roots in Sanskrit language.

UNIT-IV: Technical information about Sanskrit Literature.

UNIT-V: Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics.

Text Books:

1. Abhyaspustakam – Dr.Vishwas, 1st Edition, Samskrita-Bharti Publication, New



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Delhi

2. Teach Yourself Sanskrit, Prathama Deeksha, Vempatikutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. India's Glorious Scientific Tradition, 1st Edition, Suresh Soni, Ocean books (P) Ltd., New Delhi



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I Year - I Semester	VALUE EDUCATION	L	T	P	C
	(R23MAM1107)	2	0	0	0

Course Objectives:

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

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

Course Outcomes		Knowledge Level (K)#
CO1	Infer the knowledge of self-development	K2
CO2	Describe the importance of Human values	K2
CO3	Developing the overall personality	K6

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I: Values and self-development- Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation, Standards and principles, Value judgments

UNIT-II: Importance of cultivation of values- Sense of duty, Devotion, Self-reliance, Confidence, Concentration. Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National Unity, Patriotism. Love for nature, Discipline.

UNIT-III: Personality and Behaviour Development-Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking.

UNIT – IV: Free from anger, Dignity of labour- Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature.

UNIT – V: Character and Competence- Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively.



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Text Books:

1. Values and Ethics for organizations Theory and practice, Latest Edition,
Chakroborty, S.K., Oxford University Press, New Delhi



I Year II Semester	Machine Learning (R23MAM1201)	L	T	P	C
		3	0	3	4.5

Course Objectives:

Machine Learning course will

- Develop an appreciation for what is involved in learning from data.
- Demonstrate a wide variety of learning algorithms.
- Demonstrate how to apply a variety of learning algorithms to data.
- Demonstrate how to perform evaluation of learning algorithms and model selection.

Course Outcomes:

After the completion of the course, student will be able to

- Domain Knowledge for Productive use of Machine Learning and Diversity of Data.
- Demonstrate on Supervised and Computational Learning
- Analyze on Statistics in learning techniques and Logistic Regression
- Illustrate on Support Vector Machines and Perceptron Algorithm
- Design a Multilayer Perceptron Networks and classification of decision tree

UNIT-I:

Introduction-Towards Intelligent Machines, Well posed Problems, Example of Applications in diverse fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured / Unstructured, Forms of Learning, Machine Learning and Data Mining, Basic Linear Algebra in Machine Learning Techniques.

UNIT-II:

Supervised Learning- Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Overfitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metrics for assessing classification.

UNIT-III:

Statistical Learning- Machine Learning and Inferential Statistical Analysis, Descriptive Statistics in learning techniques, Bayesian Reasoning: A probabilistic approach to inference, K-Nearest Neighbor Classifier. Discriminant functions and regression functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.

UNIT-IV:

Support Vector Machines (SVM)-Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Large Margin Classifier for



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linearly separable data, Linear Soft Margin Classifier for Overlapping Classes, Kernel Induced Feature Spaces, Nonlinear Classifier, Regression by Support vector Machines. **Learning with Neural Networks:** Towards Cognitive Machine, Neuron Models, Network Architectures, Perceptrons, Linear neuron and the Widrow-Hoff Learning Rule, The error correction delta rule.

UNIT -V:

Multilayer Perceptron Networks and error back propagation algorithm, Radial Basis Functions Networks. **Decision Tree Learning:** Introduction, Example of classification decision tree, measures of impurity for evaluating splits in decision trees, ID3, C4.5, and CART decision trees, pruning the tree, strengths and weakness of decision tree approach.

List of Experiments:

1. Implement **Principal Component Analysis (PCA)** and **Singular Value Decomposition (SVD)** using NumPy.
2. 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.
3. 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.
4. 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.
5. Build an Artificial Neural Network by implementing the **Back propagation algorithm** and test the same using appropriate data sets.
6. Write a program to implement the **naïve Bayesian classifier** for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7. 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.
8. 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.
9. 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.
10. 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.
11. Implement the non-parametric **Locally Weighted Regression algorithm** in order to fit data points. Select appropriate data set for your experiment and draw graphs.



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12. Create the following **plots** using Matplotlib, Pandas Visualization, Seaborn on iris dataset, wine reviews datasets.
- Scatter Plot
 - Line chart
 - Histogram

Text Books:

- Applied Machine Learning, M.Gopal, McGraw Hill Education, 2019
- Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

Reference Books:

- Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
- Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.



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I Year II Semester	Deep Learning (R23MAM1202)	L	T	P	C
		3	0	0	3

Course Objectives:

The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolution neural networks.

Course Outcomes:

After completion of course, students would be able to:

- Explore feed forward networks and Deep Neural networks
- Mathematically understand the deep learning approaches and paradigms
- Apply the deep learning techniques for various applications

UNIT I:

Basics- Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm.

UNIT II:

Feedforward Networks- Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise training.

UNIT III:

Better Training of Neural Networks- Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT IV:

Recurrent Neural Networks- Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

Convolutional Neural Networks: LeNet, AlexNet. Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

UNIT V:

Recent trends- Variational Autoencoders, Transformers, GPT

Applications: Vision, NLP, Speech

Text Books:

1. Deep Learning, Ian Good fellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.



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Reference Books:

1. Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2. Pattern Recognition and Machine Learning, Christopher Bishop, 2007
3. Deep Learning with Python, François Chollet, Manning Publications, 2017



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I Year II Semester	Computer Vision (R23MAM1203)	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the Fundamental Concepts related to sources, shadows and shading
- To understand the Geometry of Multiple Views

Course Outcomes:

1. Implement fundamental image processing techniques required for computer vision
2. Implement boundary tracking techniques
3. Apply chain codes and other region descriptors, Hough Transform for line, circle, and ellipse detections.
4. Apply 3D vision techniques and Implement motion related techniques.
5. Develop applications using computer vision techniques.

UNIT –I:

CAMERAS: Pinhole Cameras Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

UNIT-II:

Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Edge Detection: Noise, Estimating Derivatives, Detecting Edges Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.

UNIT-III:

The Geometry of Multiple Views: Two Views Stereopsis: Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras Segmentation by Clustering: What Is Segmentation? Human Vision: Grouping and Gestalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,

UNIT-IV:

Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models,



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Kalman Filtering, Data Association, Applications and Examples

UNIT- V:

Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry,

Case study: Mobile Robot Localization Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Case study: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.

Text Books:

1. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.

Reference Books:

1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.
2. R. C. Gonzalez and R. E. Woods “Digital Image Processing” Addison Wesley 2008.
3. Richard Szeliski “Computer Vision: Algorithms and Applications” Springer-Verlag London Limited 2011.



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I Year II Semester	Quantum Computing (R23MAM1203)	L	T	P	C
		3	0	0	3

Course Objectives:

This course covers the basic concepts of quantum computing and problem-solving approach using finite dimensional mathematics

Course Outcomes:

- Understand basics of quantum computing
- Understand physical implementation of Qubit
- Understand Quantum algorithms and their implementation
- Understand the Impact of Quantum Computing on Cryptography

UNIT – I:

Introduction to Essential Linear Algebra: Some Basic Algebra, Matrix Math, Vectors and Vector Spaces, Set Theory. Complex Numbers: Definition of Complex Numbers, Algebra of Complex Numbers, Complex Numbers Graphically, Vector Representations of Complex Numbers, Pauli Matrices, Transcendental Numbers.

UNIT – II:

Basic Physics for Quantum Computing: The Journey to Quantum, Quantum Physics Essentials, Basic Atomic Structure, Hilbert Spaces, Uncertainty, Quantum States, Entanglement.

Basic Quantum Theory: Further with Quantum Mechanics, Quantum Decoherence, Quantum Electrodynamics, Quantum Chromodynamics, Feynman Diagram Quantum Entanglement and QKD, Quantum Entanglement, Interpretation, QKE.

UNIT – III:

Quantum Architecture: Further with Qubits, Quantum Gates, More with Gates, Quantum Circuits, The D-Wave Quantum Architecture. Quantum Hardware: Qubits, number of Qubits Needed, Addressing Decoherence, Topological Quantum Computing, Quantum Essentials.

UNIT – IV:

Quantum Algorithms: Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazirani Algorithm, Simon's Algorithm, Shor's Algorithm, Grover's Algorithm.

UNIT – V:

Current Asymmetric Algorithms: RSA, Diffie-Hellman, Elliptic Curve. The Impact of Quantum Computing on Cryptography: Asymmetric Cryptography, Specific Algorithms, Specific Applications.



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Text Books:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press
2. Dr. Chuck Easttom, Quantum Computing Fundamentals, Pearson

Reference Books:

1. Quantum Computing for Computer Scientists, Noson S. Yanofsky and Mirco A. Mannucci
2. Principles of Quantum Computation and Information, Benenti G., Casati G. and Strini G., ,
3. An Introduction to Quantum Computing Algorithms, Pittenger A. O.,



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I Year II Semester	Soft computing (R23MAM1203)	L	T	P	C
		3	0	0	3

Course Objectives:

To introduce the concepts in Soft Computing such as Artificial Neural Networks, Fuzzy logic-based systems, genetic algorithm-based systems and their hybrids.

Course Outcomes:

The Students will be able to

- Learn soft computing techniques and their applications.
- Analyze various neural network architectures.
- Define the fuzzy systems.
- Understand the genetic algorithm concepts and their applications.
- Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution

UNIT I:

Introduction to Soft Computing, Artificial neural networks, biological neurons, Basic models of artificial neural networks, Connections, Learning, Activation Functions, McCulloch and Pitts Neuron, Hebb network.

UNIT II:

Perceptron networks, Learning rule, Training and testing algorithm, Adaptive Linear Neuron, Back propagation Network, Architecture, Training algorithm

UNIT III:

Fuzzy logic, fuzzy sets, properties, operations on fuzzy sets, fuzzy relations, operations on fuzzy relations, Fuzzy membership functions, fuzzification, Methods of membership, value assignments, intuition, inference, rank ordering, Lambda – cuts for fuzzy sets, Defuzzification methods

UNIT IV:

Truth values and Tables in Fuzzy Logic, Fuzzy propositions, Formation of fuzzy rules, Decomposition of rules, Aggregation of rules, Fuzzy Inference Systems, Mamdani and Sugeno types, Neuro-fuzzy hybrid systems, characteristics , classification

UNIT V:

Introduction to genetic algorithm, operators in genetic algorithm, coding, selection, cross over, mutation, Stopping condition for genetic algorithm flow, Genetic-neuro hybrid systems, GeneticFuzzy rule based system



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Text Books:

1. S. N. Sivanandam and S. N. Deepa, Principles of soft computing – John Wiley & Sons, 2007.
2. Timothy J. Ross, Fuzzy Logic with engineering applications , John Wiley & Sons, 2016.

Reference Books:

1. N. K. Sinha and M. M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications-Academic Press /Elsevier. 2009.
2. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc. 1998
3. R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/Elsevier, 2007.
3. Driankov D., Hellendoorn H. and Reinfrank M., An Introduction to Fuzzy Control Narosa Pub., 2001.
4. Bart Kosko, Neural Network and Fuzzy Systems- Prentice Hall, Inc., Englewood Cliffs, 1992
5. Goldberg D.E., Genetic Algorithms in Search, Optimization, and Machine Learning Addison Wesley, 1989



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I Year II Semester	Robotics and Intelligent Systems (R23MAM1204)	L	T	P	C
		3	0	0	3

Course Objective:

To understand the use of robotics in building intelligent systems.

Course Outcomes:

- Enumerate the fundamentals of robotics and Artificial Intelligence (AI).
- Demonstrate how to setting up a Robot.
- Discuss about the practical Robot Design Process.
- Discuss Object Recognition Using Neural Networks and Supervised Learning

UNIT-I:

Foundation for Advanced Robotics and AI: The basic principle of robotics and AI, What is AI and what is it not, The example problem, Artificial intelligence and advanced robotics techniques, Introducing the robot and our development environment, Software components (ROS, Python, and Linux), Robot control systems and a decision-making framework, The robot control system – a control loop with soft real-time control

UNIT-II:

Setting Up Your Robot: Technical requirements, What is a robot, Robot anatomy, Subsumption architecture, Software setup, Hardware, Assembling the tracks, Mounting the tracks, Arm base assembly, Wiring.

UNIT-III:

A Concept for a Practical Robot Design Process, A systems engineering-based approach to robotics, Use cases, The problem –put away the toys, Project goals, Decomposing hardware needs, Breaking down software needs.

UNIT-IV:

Object Recognition Using Neural Networks and Supervised Learning: Technical requirements, The image recognition process, The image recognition training and deployment process – step by step, The convolution neural network process, Build the toy/not toy detector

UNIT-V:

Picking up the Toys: Technical requirements, Task analysis, Summary of robot arm learning process, Teaching the robot arm, Version one – action state reinforcement learning, Adaptive learning rate, Q-learning implementation, Google's SAC-X, Amazon Robotics Challenge

Text Books:

1. Francis X. Govers, Artificial Intelligence for Robotics: Build intelligent robots that perform human tasks using AI techniques, PACKT
2. J. J. Craig, Introduction to Robotics, Addison Wesley Publishers, 2005



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Reference Books:

1. M. Negnevitsky, Artificial Intelligence – A guide to intelligent systems
Addison-Wesley, 2005



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I Year II Semester	Reinforcement Learning (R23MAM1204)	L	T	P	C
		3	0	0	3

Course Objective:

To provide the fundamentals of Reinforcement learning.

Course Outcomes:

- Enumerate the elements of Reinforcement Learning
- Solve the n-armed Bandit problem
- Compare different Finite Markov Decision Process
- Discuss about Monte Carlo Methods in solving real world problems
- List the Applications and Case Studies of Reinforcement Learning

UNIT-I

The Reinforcement Learning Problem: Reinforcement Learning, Examples, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example: Tic-Tac-Toe, Summary, History of Reinforcement Learning.

UNIT-II

Multi-arm Bandits: An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandits, Associative Search (Contextual Bandits)

UNIT-III

Finite Markov Decision Processes: The Agent–Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation.

UNIT-IV

Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling, Incremental Implementation, Off-Policy Monte Carlo Control, Importance Sampling on Truncated Returns

UNIT-V

Applications and Case Studies: TD-Gammon, Samuel's Checkers Player, The Acrobot, Elevator Dispatching, Dynamic Channel Allocation, Job-Shop Scheduling.

Text Books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning-An Introduction", 2nd Edition, The MIT Press, 2018



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2. Marco Wiering , Martijn van Otterlo Reinforcement Learning: State-of-the-Art (Adaptation, Learning, and Optimization (12)) 2012th Edition

Reference Books:

1. Vincent François-Lavet , Peter Henderson , Riashat Islam, An Introduction to Deep Reinforcement Learning (Foundations and Trends(r) in Machine Learning) , 2019



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I Year II Semester	Generative AI (R23MAM1204)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the principles and concepts underlying Generative AI.
- Explore various types of generative models and their applications.
- Develop practical skills in implementing and training generative models.
- Evaluate the performance and limitations of different generative AI techniques.
- Analyze ethical considerations and emerging trends in Generative AI.

Course Outcomes:

Upon completion of the course, students should be able to:

- Explain the fundamental concepts of Generative AI and its applications.
- Implement and train different types of generative models, including GANs and sequence generation models.
- Critically assess the strengths and weaknesses of generative models in various domains.
- Apply generative AI techniques to real-world problems and datasets.
- Demonstrate awareness of ethical considerations in Generative AI and propose responsible solutions.

Unit I:

Introduction to Generative AI: "Drawing" Data from Models Applications of AI , The rules of probability, Why use generative models, Style transfer and image transformation

Unit-II:

Building Blocks of Deep Neural Networks Perceptrons — a brain in a function, Multi-layer perceptrons and backpropagation, Varieties of networks: Convolution and recursive, Networks for seeing: Convolutional architectures, Networks for sequence data RNNs and LSTMs

Unit-III:

Image Generation with GANs, The taxonomy of generative models Generative adversarial networks, Vanilla GAN, Improved GANs, Progeressive GAN

Unit-IV:

Deepfakes with GANs, Deepfakes overview, Modes of operation, Key feature set, High-level workflow, Replacement using autoencoders, Re-enactment using pix2pix

Unit-V:

Composing Music with Generative Models Getting started with music generation, Music generation using LSTMs, Music generation using GANs, MuseGAN — polyphonic music generation, Emerging applications in generative AI



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Text books:

1. Generative AI with Python and TensorFlow 2, Joseph Babcock, Raghav Bali
2. Hands-On Generative Adversarial Networks with Keras, Rafael Valle, Packt Publishing



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I Year II Semester	Deep Learning Lab (R23MAM1205)	L	T	P	C
		0	0	3	1.5

Course Outcomes: On completion of this course, the student will be able to

- Implement deep neural networks to solve real world problems
- Choose appropriate pre-trained model to solve real time problem
- Interpret the results of two different deep learning models

Software Packages required:

- Keras
- Tensorflow
- PyTorch

List of Experiments:

1. Implement multilayer perceptron algorithm for MNIST Hand written Digit Classification.
2. Design a neural network for classifying movie reviews (Binary Classification) using IMDB dataset.
3. Design a neural Network for classifying news wires (Multi class classification) using Reuters dataset.
4. Design a neural network for predicting house prices using Boston Housing Price dataset.
5. Build a Convolution Neural Network for MNIST Hand written Digit Classification.
6. Build a Convolution Neural Network for simple image (dogs and Cats) Classification
7. Use a pre-trained convolution neural network (VGG16) for image classification.
8. Implement one hot encoding of words or characters.
9. Implement word embeddings for IMDB dataset.
10. Implement a Recurrent Neural Network for IMDB movie review classification problem.

Text Books:

1. Reza Zadeh and Bharath Ramsundar, "Tensorflow for Deep Learning", O'Reilly publishers, 2018

References:

1. <https://github.com/fchollet/deep-learning-with-python-notebooks>



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I Year II Semester	Constitution of India (R23MAM1207)	L	T	P	C
		2	0	0	0

Course Objectives:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

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

	Course Outcomes	Knowledge Level (K)#
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.	K6
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	K6
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.	K6
CO4	Discuss the passage of the Hindu Code Bill of 1956.	K6
CO5	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.	K6

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I: History of Making of the Indian Constitution: History, Drafting



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Committee, (Composition & Working)

Philosophy of the Indian Constitution- Preamble, Salient, Features

UNIT-II: Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III: Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, **Executive-** President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT-IV: Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT-V: Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books:

1. The Constitution of India, 1st Edition, (Bare Act), Government Publication, 1950
2. Framing of Indian Constitution, 1st Edition, Dr. S. N. Busi, Dr. B. R. Ambedkar 2015

Reference Books:

1. Indian Constitution Law, 7th Edition, M. P. Jain, Lexis Nexis, 2014



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I Year II Semester	Pedagogy Studies (R23MAM1207)	L	T	P	C
		2	0	0	0

Course Objectives:

Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

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

	Course Outcomes	Knowledge Level (K)#
CO1	What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?	K1
CO2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?	K1
CO3	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?	K1

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I: Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

UNIT-II: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

UNIT-III: Evidence on the effectiveness of pedagogical practices: Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy, Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and



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pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV: Professional development: Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V: Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Text Books:

1. Classroom interaction in Kenyan primary schools, Ackers J, Hardman F, Compare, 31 (2): 245-261, 2001
2. Curricular reform in schools: The importance of evaluation, Agrawal M, Journal of Curriculum Studies, 36 (3): 361-379, 2004

Reference Books:

1. Teacher training in Ghana: does it count? Multi-site teacher education research project (MUSTER) country report 1, Akyeampong K, London: DFID, 2003



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I Year II Semester	Stress Management by Yoga (R23MAM1207)	L	T	P	C
		2	0	0	0

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

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

	Course Outcomes	Knowledge Level (K)#
CO1	Develop healthy mind in a healthy body thus improving social health also	K2
CO2	Improve efficiency	K6

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT – I: Definitions of Eight parts of yoga. (Ashtanga).

UNIT – II: Yam and Niyam. Do`s and Don`ts in life.

UNIT – III: Ahinsa, satya, astheya, bramhacharya and aparigrahaShaucha, santosh, tapa, swadhyay,ishwarpranidhan.

UNIT –IV: Asan and Pranayam, Various yoga poses and their benefits for mind &body.

UNIT –V: Regularization of breathing techniques and its effects-Types of pranayam.

Text Books:

1. Yogic Asanas for Group Tarining-Part-I :Janardan Swami Yogabhyasi Mandal, Nagpur
2. Rajayoga or conquering the Internal Nature, Swami Vivekananda, Advaita Ashrama Publication Department, Kolkata



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I Year II Semester	Personality Development through Life Enlightenment Skills (R23MAM1207)	L	T	P	C
		2	0	0	0

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

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

	Course Outcomes	Knowledge Level (K)#
CO1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life	K2
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity	K3
CO3	Study of Neetishatakam will help in developing versatile personality of students.	K5

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I: Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29, 31, 32 (pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52, 53, 59 (don'ts), Verses- 71,73,75,78 (do's)

UNIT-II: Approach to day to day work and duties.
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47, 48

UNIT-III: Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17, 23,35, Chapter 18- Verses 45, 46, 48

UNIT-IV: Statements of basic knowledge.
Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16, 17, 18



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UNIT-V: Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17,
Chapter 3-Verses 36, 37, 42,
Chapter 4-Verses 18, 38, 39
Chapter18 – Verses 37, 38, 63

Text Books:

1. Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (PublicationDepartment), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya), P.Gopinath

Reference Books:

1. Rashtriya Sanskrit Sansthanam, New Delhi.



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II Year I Semester	Natural Language Processing with Deep Learning (R23MAM2101)	L	T	P	C
		3	0	0	3

Course Objectives:

This course introduces the fundamental concepts and techniques of natural language processing (NLP).

- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

Course Outcomes:

After completion of this course

- Demonstrate a given text with basic Language features
- To design an innovative application using NLP components
- Explain a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast the use of different statistical approaches for different types of NLP applications.

UNIT I:

INTRODUCTION: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II:

WORD LEVEL ANALYSIS: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III:

SYNTACTIC ANALYSIS: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures



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UNIT IV:

SEMANTICS AND PRAGMATICS: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT V:

DISCOURSE ANALYSIS AND LEXICAL RESOURCES: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books:

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Daniel Jurafsky, James H. Martin -Pearson Publication, 2014.
2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, O'Reilly Media, 2009.

Reference Books:

1. Language Processing with Java and Ling Pipe Cookbook, 1st Edition, Breck Baldwin, Atlantic Publisher, 2015.
2. Natural Language Processing with Java, 2nd Edition, Richard M Reese, O'Reilly Media, 2015.
3. Handbook of Natural Language Processing, Second, Nitin Indurkha and Fred J. Damerau, Chapman and Hall/CRC Press, 2010. Edition
4. Natural Language Processing and Information Retrieval, 3rd Edition, Tanveer Siddiqui, U.S. Tiwary, Oxford University Press, 2008.