GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY

Guru Gobind Singh Indraprastha University
Sector – 16C Dwarka, New Delhi – 110078

(Coordination Branch)
Ph:011-25302135-136, Email: coordination112@gmail.com, Website: www.ipu.ac.in

F.No.: GGSIPU/Co-ord./50th AC/2021/ 121 **Dated:** 2nd **July, 2021**

Circular

Please find enclosed herewith the final Minutes of the 50th meeting of the Academic Council of the Guru Gobind Singh Indraprastha University held on **11/06/2021 at 11:00 AM** on Cisco Webex platform.

Ravi Dadhich

(Ravi Dadhich)
Registrar

To,

1 Dean- USBAS/ USBT/ USCT/ USEM/ USICT/ USHSS/ USMC/ USLLS/ USM&PMHS/ USMS/ USAP/ USE, GGSIP University.
2 Director- Academic Affairs/ Coordination/ Students' Welfare/ CDMS/ Development/ International Affairs/ CEPS/ Research and Consultancy/ Legal Aid / IUIIC, GGSIP University
3 Librarian, GGSIP University
4 Prof. P.K. Jhulka, (Retired), Max Institute of Cancer Care, 26-A Ring Road, Nirmal Puri, Nirmal Colony, Block -2, Lajpat Nagar-IV, New Delhi-110024
5 Prof. M.C. Sharma, 109, Nav Shakti Sadan, Sector 13, Rohini, New Delhi-110085
6 Prof. Karmeshu, (Retired), 150, Deepali, Road No. 42, Pitampura, Delhi-110034
7 Sh. Arvind Misra, 5/101, Mathura Road, Agra-282002
8 Shri. Sandeep Gupta, 100 UB Jawahar Nagar, Delhi-110007
9 Prof. Rajiv Bhat, School of Biotechnology, Jawaharlal Nehru University, New Delhi
10 Prof. (Dr.) Pradeep Kulshrestha, Dean, School of Law, Sharda University, Plot No. 32 & 34, Knowledge Part-III, Greater Noida-201306 (UP)
11 Ar. Rupal S. Randhawa, 204-A, Pocket B, Mayur Vihar, P hase-2, New Delhi-110091
12 Dr. Jagdish Lal Gupta, CP-18, Maurya Enclave, Pitam Pura, Delhi-110034.
13 Prof. M. Afzal Wani, University School of Law and Legal Studies, GGSIP University
14 Prof. Prodyut Bhattacharya, University School of Environment Management, GGSIP University
15 Prof. Amit Prakash Singh, University School of Information Communication & Technology, GGSIP University
16 Prof. Shalini Garg, University School of Management Studies, GGSIP University.
17 Prof. Lisa P. Lukose, University School of Law and Legal Studies, GGSIP University.
18 Prof. M.N. Hoda, Director, Bharti Vidhyapeeth's Institute of Computer Application & Management, A-4, Paschim Vihar, Rohtak Road, New Delhi-63.
19 Prof. Sonia Jindal, Principal, Gitarattan Institute of Advanced Studies and Training, Rohini, Delhi-85.
20 Prof. Ravi K. Dhar, Director, Jagannath International Management School, OCF, Pocket-9, Sector-B, Vasant Kunj, New Delhi-110070.
21 Prof. Maharaj Krishen Bhat, Director, Maharaja Agrasen Institute of Management Studies, Maharaja Agrasen Camp, Plot No. 1, Sec-22, Rohini, Delhi.

Copy for information of the Competent Authority:

(i) AR to the Vice Chancellor Secretariat for kind information of Hon'ble Vice Chancellor, GGSIP University.
(ii) AR to the Registrar office for information of Registrar, GGSIP University

Shikha

(Shikha Agarwal)
Dy. Registrar (Coordination)

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY
SECTOR – 16 C, DWARKA, NEW DELHI - 110078

GURU GOBIND SINGH
INDRAPRASTHA
UNIVERSITY

FIFTIETH (50th) MEETING OF THE ACADEMIC COUNCIL

DATE : 11.06.2021

TIME : 11:00 AM

MINUTES OF 50th MEETING OF THE ACADEMIC COUNCIL

Ravi

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21	AC 50.21	To ratify the recommendations of the subcommittee of Academic Council by Hon'ble Vice Chancellor to consider the case of detention of Two (02) students of 3rd year of batch 2017 of Ch. Brahm Prakash Govt. Engineering College (CBPGEC)	10
22	AC 50.22	To consider and approve the revised Scheme & Syllabus of M.Tech. (Nano Science and Technology) programme in accordance with AICTE and CBCS options.	10
23	AC 50.23	To consider and approve the revised Scheme & Syllabus of M.Tech. (Engineering Physics) programme in accordance with AICTE and CBCS options with change in the title of course code BAEPC:602 may be modified to "Photovoltaic Technologies" in place of "Solar Photo-voltaic Technologies".	11
24	AC 50.24	To ratify the Admission and Selection Criteria, Syllabus for Entrance Examination, Scheme & Syllabus of M.Sc. Packaging Technology programme in Indian Institute of Packaging, Delhi to be started from the Academic Session 2021-22 under the aegis of USBAS.	11
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32	AC 50.32	Syllabus, Course code and credits of the course Environmental Studies (as proposed by the UGC and AICTE) to be offered to all the Undergraduate Programmes in the University School of Studies as Ability Enhancement Compulsory Course (AECC)	12
33	AC 50.33	Syllabus, course code and credits of the course Environmental Studies as Ability Enhancement Elective Course (AEEC)to be offered in the Postgraduate Programme in the University School of Studies	13
34	AC 50.34	To ratify the Mode of Admission, Eligibility Criteria, Number of	13

The Academic Council considered and approved the revised Scheme & Syllabus of M.Tech. (Nano Science and Technology) programme in accordance with AICTE and CBCS options w.e.f. Academic Session 2021-22.

Agenda Item No. AC 50.23: **To consider and approve the revised Scheme & Syllabus of M.Tech. (Engineering Physics) programme in accordance with AICTE and CBCS options with change in the title of course code BAEPC: 602 may be modified to "Photovoltaic Technologies" in place of "Solar Photo-voltaic Technologies".**

The Academic Council considered and approved the revised Scheme & Syllabus of M.Tech. (Engineering Physics) programme in accordance with AICTE and CBCS options with change in the title of course code BAEPC: 602 may be modified to "Photovoltaic Technologies" in place of "Solar Photo-voltaic Technologies" w.e.f. Academic Session 2021-22.

Agenda Item No. AC 50.24: **To ratify the Admission and Selection Criteria, Syllabus for Entrance Examination, Scheme & Syllabus of M.Sc. Packaging Technology programme in Indian Institute of Packaging, Delhi to be started from the Academic Session 2021-22 under the aegis of USBAS.**

The Academic Council ratified the Admission and Selection Criteria, Syllabus for Entrance Examination, Scheme & Syllabus of M.Sc. Packaging Technology programme in Indian Institute of Packaging, Delhi to be started from the Academic Session 2021-22 under the aegis of USBAS.

The Admission and other criteria shall be as per the University policy as being adopted for other programme of the University

Agenda Item No. AC 50.25: **To ratify the revision of Scheme & Syllabus of MCA degree from 3 years to 2 years- affiliated institutes w.e.f. Academic Session 2020-2021 onwards.**

The Academic Council ratified the revision of Scheme & Syllabus of MCA degree from 3 years to 2 years- affiliated institutes w.e.f. Academic Session 2020-2021.

Agenda Item No. AC 50.26: **To ratify the revision of Scheme & Syllabus of MCA- Software Engineering at USIC&T (1st to 4th Semester Scheme and Bridge courses) alongwith the change in the duration of the MCA programme from 3 years to 2 years.**

The Academic Council ratified the revision of Scheme & Syllabus of MCA- Software Engineering at USIC&T (1st to 4th Semester Scheme and Bridge courses) alongwith the

change in the duration of the MCA programme from 3 years to 2 years w.e.f. Academic Session 2020-2021.

Agenda Item No. AC 50.27: **To ratify the Scheme & Syllabus of Ph.D. course work at USIC&T for the Academic Session 2020-2021 onwards.**

The Academic Council ratified the Scheme & Syllabus of Ph.D. course work at USIC&T w.e.f. Academic Session 2020-2021.

Agenda Item No. AC 50.28: **Change in nomenclature of PhD degree offered by USEM from Ph.D. in Environment Management to Ph.D. in Environmental Science**

The Academic Council considered and approved the change in nomenclature of Ph.D. degree offered by USEM from Ph.D. in Environment Management to Ph.D. in Environmental Science.

Agenda Item No. AC 50.29: **Revised Scheme of Examination and Syllabus of M.Sc. Environment Management as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF)**

The Academic Council considered and approved the Revised Scheme of Examination and Syllabus of M.Sc. Environment Management as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF) w.e.f. Academic Session 2021-22.

Agenda Item No. AC 50.30: **Revised Scheme of Examination and Syllabus of M.Sc. Biodiversity and Conservation as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF)**

The Academic Council considered and approved the Revised Scheme of Examination and Syllabus of M.Sc. Biodiversity and Conservation as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF) w.e.f. Academic Session 2021-22.

Agenda Item No. AC 50.31: **Revised Scheme of Examination and Syllabus of M.Sc. Natural Resource Management as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF)**

The Academic Council considered and approved the Revised Scheme of Examination and Syllabus of M.Sc. Natural Resource Management as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF) w.e.f. Academic Session 2021-22.

Agenda Item No. AC 50.32: **Syllabus, Course code and credits of the course Environmental Studies (as proposed by the UGC and AICTE) to be offered to all the**

SCHEME OF EXAMINATION

&

DETAILED SYLLABUS

(w. e. f. Academic Year 2020-2021 onwards)

For

MASTER OF COMPUTER

APPLICATIONS IN

SOFTWARE ENGINEERING (MCA-SE) DEGREE

(02 Years)

Offered at USIC&T, of GGSIPU

Entrepreneurship | Employability | Skill Development

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY
SECTOR 16C, DWARKA, NEW DELHI

Programme Outcomes for MCA(SE)

1. Computational Knowledge:
Apply knowledge of computing fundamentals, computing specialisation, mathematics, and domainknowledge appropriate for the computing specialisation to the abstraction and conceptualisation ofcomputing models from defined problems and requirements.

2. Problem Analysis:
Identify, formulate, research literature, and solve complex computing problems reachingsubstantiated conclusions using fundamental principles of mathematics, computing sciences, andrelevant domain disciplines.

3. Design /Development of Solutions:
Design and evaluate solutions for complex computing problems, and design and evaluate systems,components, or processes that meet specified needs with appropriate consideration for public healthand safety, cultural, societal, and environmental considerations.

4. Conduct Investigations of Complex Computing Problems:
Use research-based knowledge and research methods including design of experiments, analysis andinterpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern Tool Usage:
Create, select, adapt and apply appropriate techniques, resources, and modern computing tools tocomplex computing activities, with an understanding of the limitations.

6. Professional Ethics:
Understand and commit to professional ethics and cyber regulations, responsibilities, and norms ofprofessional computing practice.

7. Life-long Learning:
Recognise the need, and have the ability, to engage in independent learning for continualdevelopment as a computing professional.

8. Project management and finance:
Demonstrate knowledge and understanding of the computing and management principles and applythese to one's own work, as a member and leader in a team, to manage projects and in
multidisciplinary environments.

9. Communication Efficacy:
Communicate effectively with the computing community, and with society at large, about complexcomputing activities by being able to comprehend and write effective reports, design documentation,make effective presentations, and give and understand clear instructions.

10. Societal and Environmental Concern:
Understand and assess societal, environmental, health, safety, legal, and cultural issues within localand global contexts, and the consequential responsibilities relevant to professional computingpractice.

11. Individual and Team Work:
Function effectively as an individual and as a member or leader in diverse teams and inmultidisciplinary environments.

12. Innovation and Entrepreneurship
Identify a timely opportunity and using innovation to pursue that opportunity to create value andwealth for the betterment of the individual and society at large

Scheme of Study (MCA-SE)

FIRST SEMESTER EXAMINATION

Paper ID	Paper Code	Paper	L	T/P	Credit
44601	IT601	Database Management System	3	1	4
44603	IT603	Computer Organization and Architecture	3	1	4
44605	IT605	Software Engineering	3	1	4
44607	IT607	Data Structure and Algorithm	3	1	4
44609	IT609	Foundation of Computer Science	3	1	4
44611	IT611	Object Oriented Programming	3	1	4
Practical					
44661	IT661	Database Management System Lab	0	2	1
44663	IT663	Data Structure and Algorithm Lab	0	2	1
44665	IT665	Software Engineering Lab	0	2	1
44667	IT667	Object Oriented Programming Lab.	0	2	1
44669	IT669	Term Paper I (NUES*)	0	4	2
		Total	18	18	30

NUES*

The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. The student will have to present the progress of the work through seminars and progress reports.

Scheme of Study (MCA-SE)

SECOND SEMESTER EXAMINATION

Paper ID	Paper Code	Paper	L	T/P	Credit
44602	IT602	Data Communication and Networking	3	1	4
44604	IT604	Operating Systems	3	1	4
44606	IT606	Software Testing and Quality Assurance	3	1	4
44608	IT608	AI and Machine Learning	3	1	4
44626	IT626	Human Values and Professional Ethics (NUES)	2		2
Core (School) Elective – I (Select any one)					
		Select one from the list of school electives.	4	0	4
Open Elective – I (Select any one)					
		Electives offered by USIC&T or any other School of the University or online courses through Swayam/NPTELMOOCs with the approval of the academic programme committee			Minimum. 3 Credits
Practical					
44662	IT662	Software Testing and Quality Assurance Lab	0	2	1
44664	IT664	Lab Based on Electives	0	2	1
44666	IT666	Term Paper II (NUES*)	0	4	2
		Total	18	12	29

**** If the paper is taken from the list below, then the same paper cannot be taken as Core as well as open elective.**

School Electives List I					
44610	IT610	Software Requirement & Elicitation	4	0	4
44628	IT628	Computer Graphics & Multimedia	4	0	4
44614	IT614	Internet of Things	4	0	4
44616	IT616	Theory of Computation	4	0	4
44618	IT618	Optimization Techniques	4	0	4
44620	IT620	Front End Design Techniques	4	0	4
44622	IT622	Simulation and Modelling	4	0	4
44624	IT624	Mobile Computing	4	0	4

Scheme of Study (MCA-SE)

THIRD SEMESTER EXAMINATION

Paper ID	Paper Code	Paper	L	T/P	Credit
44701	IT701	Data Analytics	3	1	4
44703	IT703	Software Project Management	3	1	4
44705	IT705	Mobile Architecture and Programming	3	1	4
44747	MEES611	Environmental Studies	2		2
Core (School) Elective –II (Select any one)					
44707	IT707	Design Patterns	4	0	4
44709	IT709	Compiler Design	4	0	4
44711	IT711	Block chain Technology	4	0	4
44713	IT713	E-commerce	4	0	4
44715	IT715	Cloud Computing	4	0	4
44717	IT717	Semantic Web Technologies	4	0	4
44719	IT719	Natural Language Processing	4	0	4
44721	IT721	Advanced Database Management Systems	4	0	4
44723	IT723	Social Network Analysis	4	0	4
44725	IT725	Scientific Computing in Python	4	0	4
Core (School) Elective –III (Select any one)					
44727	IT727	Agile Methodology and DevOps	4	0	4
44729	IT729	Object Oriented Analysis and Design	4	0	4
44731	IT731	Network Security	4	0	4
44733	IT733	Cyber Security	4	0	4
44735	IT735	Soft Computing	4	0	4
44737	IT737	Big Data and Nosql	4	0	4
44739	IT739	Nature Inspired Algorithms	4	0	4
44741	IT741	Advanced Computer Architecture	4	0	4
44743	IT743	Software Defined Networks	4	0	4
44745	IT745	Digital Image Processing	4	0	4
Open Elective –II (Select any one)					
		Electives offered by USIC&T or any other School of the University or online courses through Swayam/NPTELMOOCs with the approval of the academic programme committee			Minimum. 3 Credits
Practical					
44761	IT761	Data Analytics Lab	0	2	1
44763	IT763	Software Project Management Lab	0	2	1
44765	IT765	Mobile Programming Lab	0	2	1
44767	IT767	Technical Report Writing (NUES*)	0	2	1
		Total	18	11	29

** The students may choose one of the papers from the Elective List II or III as an open elective, but the paper should be distinct from the paper for core elective for a specific student.

Scheme of Study (MCA-SE)

FOURTH SEMESTER EXAMINATION

Paper ID	Paper Code	Paper	L	T/P	Credit
44762	IT762	Dissertation (Major Project) / Internship Report	-	-	20
44764	IT764	Seminar and Presentation based on Dissertation (NUES*)	-	-	4
		Total	-	-	24

Bridge Courses for non computer science students

Paper ID	Paper Code	Paper	L	T/P
44501	SE501	Introduction to Programming in C	3	1
44502	SE502	Introduction to IT	3	1
44503	SE503	Digital Electronics	3	1
44504	SE504	Web Technology	3	1
		Total	12	4

Note: Students have to do the Bridge courses through Swayam/NPTEL/as decided by the Academic Programme Committee (APC) of the School. These papers have to be qualified by the students. For these papers examination shall be conducted, on qualifying the course as offered by Swayam/NPTL, by the School as NUES, the same shall be transferred to examination division of the University. The degree to be awarded to the student only subject to the acquiring qualifying grade/marks in the bridge courses and the minimum credits in the regular courses of the scheme of study for 1-4 semesters. These Courses shall be qualifying in nature; they shall not be included for calculation of CGPA. The qualifying marks shall be 40 marks in each paper.

Note:

1. At least two Electives shall be offered in every group of electives by the school as decided by the Academic Programme Committee of the school. And, from these electives, an elective shall be offered if at least one third of the class is desirous of studying the paper. Students must choose from the papers offered by the school.
2. Ordinance: The evaluation shall be as per the Ordinance 11 of the University.
3. Maximum and minimum duration: Minimum duration of study shall be N = 2 years (M= 4 semesters) while the maximum duration of registration of the students shall be N+2 years (M + 4 semesters) as per Ordinance 11 of the University.
4. Maximum and Minimum Credits: The total number of the credits of the MCA(SE) programme (Maximum credits) shall be the total number of credits taken by the student subject to acquiring a minimum of 104 credits for the award of the degree.
   The minimum curriculum study requirement for the student shall be 112 credits. The actual number of credits studied by the student can be higher on choice of open electives.
5. The practical shall be based on the syllabus of the Theory Paper. The list of practical to be decided by the Academic Programme Committee of USICT

NUES: No End-Term Exam would be held for this course. Marks out of 100 shall be awarded as the continuous evaluation of the performance. The evaluation modalities shall be decided by the academic program committee of the school.

Paper ID: 44601		**L**	**T/P**	**C**
Code: IT601	**Paper: Database Management System**	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Ability to design a relational database model.
CO 2	Ability to write programs in SQL and PL/SQL
CO 3	Ability to apply the knowledge of good database design (normal forms).
CO4	Ability to construct transaction management routines.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	2	-	1	-	-	-	1	-
CO2	3	3	3	-	2	-	1	-	-	-	1	-
CO3	3	3	3	-	2	-	1	-	-	-	1	-
CO4	3	3	3	-	2	-	1	-	-	-	1	-

UNIT 1

Basic concepts: database & database users, characteristics of the database systems, concepts and architecture, date models, schemas & instances, DBMS architecture & data independence, database languages & interfaces, data modelling using the entity-relationship approach. Extended ER concepts - Specialization/Generalization, Aggregation, Mapping of ER model to Relational Model

UNIT 2

Relational model concepts, relational model constraints, relational algebra, SQL – DDL, DCL & DML views and indexes in SQL, PL/SQL Programming, Stored Procedures, User Defined Functions, Cursors, Error Handling, Triggers.

UNIT 3

Relational data base design: functional dependencies & normalization for relational databases, normal forms based on functional dependencies, (1NF, 2NF, 3NF & BCNF), lossless join and dependency preserving decomposition, normal forms based on multivalued & join dependencies (4NF & 5NF) & domain key normal form. Properties of Transaction, Transaction states, Transaction Schedule

UNIT 4

Serializability, Concurrency control techniques: locking techniques, time stamp ordering, Recoverable schedules, granularity of data items, Deadlock detection and Recovery, recovery techniques: recovery concepts, database backup and recovery from catastrophic failures. Concepts of Object Oriented Database Management systems & Distributed Database Management Systems

Text Books:

1. R. Elmsari and S. B. Navathe, "Fundamentals of database systems", Pearson Education, 7th Edition, 2018

Reference Books:

1. A. Silberschatz, H. F. Korth and S. Sudershan, "Database System Concept", McGraw Hill, 6th Edition,2013.
2. Date, C. J., "An introduction to database systems", 8th Edition, Pearson Education, 2008.
3. P. Rob & C. Coronel, "Database Systems: Design Implementation & Management", Thomson Learning, 6th Edition, 2004
4. Desai, B., "An introduction to database concepts", Galgotia publications, 2010

Paper ID:44603 **L** **T/P** **C**
Code:IT603 **Paper: Computer Organization and Architecture** **3** **1** **4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Ability to understand the data representations, basic operations on data, and components of computer architecture.
CO 2	Ability to apply the knowledge of Basic Computer Organization and Design.
CO 3	Ability to analyze the Input – Output interfacing and memory Organization.
CO 4	Ability to understand the parallel processing, pipeline concept and multiprocessors.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	1	1	2	1	-	-	-	1
CO2	3	2	3	2	-	1	2	1	-	-	-	1
CO3	2	2	2	2	-	1	2	1	-	-	-	1
CO4	3	2	2	2	1	1	2	1	-	-	-	1

UNIT 1

Data Representation: Binary numbers, binary codes, fixed point representation, floating point representation, error detection codes. Computer Arithmetic: Introduction, addition and subtraction, multiplication algorithms, division algorithms, floating point arithmetic operation, decimal arithmetic unit, decimal arithmetic operations. Register Transfer and Micro operation: Register transfer language, register transfer, bus and memory transfer, arithmetic microoperations, logic micro operations, shift micro operations.

UNIT 2

Basic Computer Organization and Design: Instruction codes, computer registers, computer instructions, timing & control, instruction cycle, memory reference instructions, input- output and interrupts, design of basic computer, design of accumulator logic. Microprogrammed Control Unit: Control memory, address sequencing. Central Processing Unit: Introduction, general register organization, stack organization, instruction formats, addressing modes. RISC and CISC.

UNIT 3

Input – Output Organization: Peripheral devices, input – Output interface, asynchronous data transfer, modes of data transfer, priority interrupt, direct memory access, input – output processor. Memory Organization: Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory, memory management hardware.

UNIT 4

Parallel Processing, Loosely and Tightly Coupled Processors, Amadhl's Law, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processors, Multiprocessors, Interconnection Structures. Inter-processor Arbitration, Communication and Synchronization. Cache Coherence.

Text Books:

1. M. Morris Mano, Rajib Mall "Computer System and Architecture", Revised Third Edition Pearson Education, 2017

Reference Books:

1. Pal Chaudhuri, P. "Computer Organization & Design", 3rd Edition, PHI, 2009.
2. Hayes J.P, "Computer Architecture and Organization", Mc Graw Hill,1978.
3. Stallings, W. "Computer Organization & Architecture", 10th Edition Pearson Education 2016.

Paper ID: 44605		**L**	**T/P**	**C**
Code: IT605	**Paper: Software Engineering**	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks:75
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Entrepreneurship, Employability & Skill Development

Course Outcomes:

CO1	Ability to use understand the software process models.
CO2	Ability to analyse the requirements and to design, develop, and maintain the software systems.
CO3	Ability to estimate the size and cost of software projects.
CO4	Ability to design and execute the test cases for software systems using different testing techniques.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	1	-	-	1	2	3	-	1	2
CO 2	3	3	3	1	2	-	1	3	3	-	1	1
CO 3	3	3	3	1	-	-	1	2	3	-	1	-
CO 4	3	3	3	1	2	-	1	1	3	-	1	1

UNIT 1

Software Process Models: Software Process, Generic Process Model – Framework Activity, Task Set and Process Patterns; Process Lifecycle, Prescriptive Process Models –Waterfall, incremental, Evolutionary concurrent models. Agile Process Models – Extreme Programming (XP), Adaptive Software Development, Scrum, Dynamic System Development Model, Feature Driven Development, Crystal.

UNIT 2

Software Requirements: Functional and Non-Functional Requirements; Eliciting Requirements, Developing Use Cases, Requirement Analysis and Modelling; Requirements Review, Software Requirement and Specification (SRS) Document. Estimation and Scheduling of Software Projects:Software Sizing, LOC and FP based Estimations; Estimating Cost and Effort; Estimation Models, Constructive Cost Model (COCOMO), Project Scheduling and Staffing; Time-line Charts.

UNIT 3

Software Design: Abstraction, Architecture, Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Cohesion and Coupling; Object-Oriented Design, Data Design, Architectural Design, User Interface Design, Component Level Design.Software Quality: McCall's Quality Factors, ISO 9126 Quality Factors, Quality Control, Quality Assurance, Risk Management, Risk Mitigation, Monitoring and Management (RMMM); Software Reliability.

UNIT 4

Software Testing: Verification and Validation; Error, Fault, Bug and Failure; Unit and Integration Testing; White-box and Black-box Testing; Basis Path Testing, Control Structure Testing, Deriving Test Cases, Alpha and Beta Testing; Regression Testing, Performance Testing, Stress Testing. Software Configuration Management: Change Control and Version Control; Software Reuse, Software Re-engineering, Reverse Engineering.Component Based Development, Aspect-Oriented Software Development, Formal Methods.

Text Books:

1. Roger S. Pressman, "Software Engineering- A Practitioner's Approach", Eighth Edition, McGraw-Hill International Edition, 2010.
2. K.K. Aggarwal &Yogesh Singh, "Software Engineering", New Age International Publishers, New Delhi, Third Edition, 2008.

Reference Books:

3. Pankaj Jalote,"A Concise Introduction to Software Engineering", Springer, 2008.
4. Ian Sommerville, "Software Engineering", 10th edition, Pearson, 2018.

5. Stephan Schach, "Software Engineering", McGraw Hill, 2008
6. CemKaner, Jack Falk, Nguyen Quoc, "Testing Computer Software", Second Edition, Van Nostrand Reinhold, New York, 1993.
7. GojkoAszic, "Specification by Example", Manning Publications, 2011.
8. Kent Back, "Test-Driven Development By Example", Pearson Education, 2003.
9. Boris Beizer, "Software System Testing and Quality Assurance", Van Nostrand Reinhold, New York, 1984.
10. Mike Cohn, "Software Development Using Scrum Succeeding with Agile", Pearson Education.

Paper ID: 44607		**L**	**T/P**	**C**
Code: IT607	**Paper: Data Structure and Algorithm**	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability & Skill Development

Course Outcomes:

CO 1	Be able to understand the difference between data structure and structured data with few examples such as stack, queue and link list
CO 2	Ability to model different types of trees, balance trees and graphs
CO 3	Ability to analyze the time/ space complexity and understanding different kinds of searching/ sorting algorithms
CO 4	Ability to apply the knowledge of dynamic paradigm, greedy paradigm and idea of NP complete problems.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	3	2	-	-	2	1
CO2	3	3	3	3	3	-	3	2	-	-	2	1
CO3	3	3	3	3	3	-	3	2	-	-	2	1
CO4	3	3	3	3	3	-	3	2	-	-	2	1

UNIT – I

Introduction to data structures, arrays and its applications, Sparse Matrix, singly linked lists, doubly linked lists, circular list, Implementation of stacks and queues using arrays and linked lists, circular queues, applications of stack and queue.

UNIT – II

Trees, Binary Tree, terminology, representation, Binary Search tree (insertion, deletion and different traversals techniques), AVL Trees, B tree, B+ trees, Data Structure for Sets, disjoint sets implementation

Graph Algorithms: Terminology, Representation, Graph traversals, Breadth-First Search, Depth-First Search, Shortest Paths, Minimum Spanning Trees.

UNIT – III

Notion of Algorithm, Growth of functions, Use of Big O , Θ etc. in analysis, Summations, Recurrences: The substitution method, The iteration method, The master method,

Searching Techniques: Sequential Search Binary Search, hashing

Sorting techniques: Insertion Sort, Divide and conquer Paradigm of Problem solving (Merge sort, Quick Sort), Priority Queues implementation using Heap, sorting in linear time (count sort, radix sort, bucket sort).

UNIT – IV

Design Techniques with examples: Dynamic Programming, Greedy Algorithms, Concepts of P, NP and NP hard and NP complete Class Problems; NP-completeness and Reducibility, Introduction to the concepts of Approximation Algorithms.

Textbook(s):

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", PHI Learning Pvt. Ltd. (Originally MIT Press); Third edition (February 2, 2010)

2. Ellis Horowitz, SartajSahni, Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, 2008, University Press
3. Ellis Horowitz, SartajSahni, S. Rajeshkaran, Fundamentals of Computer algorithm, University Press, Jan 2008,

References:

1. R.Kruse, C.L. Tondo, BP Leung, Shashi M, "Data Structures and Program Design in C", Second Edition, Pearson Education.
2. Jon Kleinberg and Eva Tardos , "Algorithm Design", Pearson Edition, 2006.
3. SanjoyDasgupta , . "Algorithms", Christos Papadimitriou UmeshVazirani TMH
4. A.S.Tanenbaum, Y. Langsam, and M.J. Augenstein, "DataStructures Using C", Pearson Education
5. B.W. Kernighan, Dennis M.Ritchie, "The C Programming Language", Pearson Education
6. S. Sahni and E. Horowitz, "Data Structures", Galgotia Publications.
7. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2003.
8. Kamthane, "Introduction to Data Structure in C", Pearson Education
9. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education
10. Sara Baase and Allen Van Gelder, "Computer Algorithms - Introduction to Design and Analysis", Pearson Education
11. B.A. Forouzan and R.F. Gilberg, "Computer science, a structured programming approach using C" , Third edition, Cengage Learning.
12. A.V.Aho, J.E. Hopcroft and J.D.Ullman, "The Design and Analysis Of Computer Algorithms", Pearson Education
13. Seymour Lipschutz, Data Structures, Schaum Series, Mc Graw Hills

Paper ID: 44609		**L**	**T/P**	**C**
Code:IT609	**Paper: Foundation of Computer Science**	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Ability to utilize the techniques for constructing mathematical proofs and counting principles
CO 2	Develop computational thinking to approach tractable problems
CO 3	Ability to apply the basics of number theory.
CO 4	Ability to inspect the graph theoretic algorithm to lay down foundation for complex data analytic

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	-	3	2	-	-	2	1
CO2	3	2	3	2	3	-	3	2	-	-	2	1
CO3	3	3	3	2	3	-	3	2	-	-	2	1
CO4	3	2	3	2	3	-	3	2	-	-	2	1

UNIT 1

Sets, Relation, and Number theory: Sets and Relations: Set Operations, Representation and Properties of Relations, Equivalence Relations, Partially Ordering. Mathematical Induction,Basics of Counting, Pigeonhole Principle, Permutations and Combinations, Inclusion- Exclusion Principle, Modular arithmetic, Prime numbers, congruences (linear and quadratic)

UNIT 2

Logic, Inferencing, and Recurrences: Mathematical Logic: Propositional and Predicate Logic, Propositional Equivalences, Normal Forms, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Proof by Resolution, Recurrence relations, solution methods for linear, first-order recurrence relations with constant coefficients.

UNIT 3

Group theory: Group identity and uniqueness, inverse and its uniqueness, isomorphism and homomorphism, subgroups, Cosets and Lagrange's theorem, Permutation group, Normal subgroup and quotient groups. Overview of Rings, Field and polynomials, Finite fields and some applications, Error Correcting codes (Linear and circular codes).

UNIT 4

Graph theory**:** Graph terminology, Paths and Circuits, Shortest Paths in Weighted Graphs, spanning trees, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, Planner graph, Graph Coloring, Fivecolor Theorem, Matching in Bipartite Graphs.

Text Books:

1. Kenneth Rosen, "Discrete Mathematics and Its Applications", McGrawHill,2017

Reference Books:

1. Norman L. Biggs, "Discrete Mathematics", Second edition, Oxford University Press, New Delhi, 2002.
2. J.P. Tremblay & R. Manohar, "Discrete Mathematical Structure with Application to Computer Science," TMH, New Delhi,2000.
3. Kolman, Busby &Ross "Discrete Mathematical Structures", 6th edition, PHI/Pearson, 2009.

Paper ID: 44611		**L**	**T/P**	**C**
Code: IT611	**Paper: Object Oriented Programming**	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks : 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability & Skill Development

Course Outcomes:

CO1	Explain the fundamentals of an OOP language and various features of C++ to support OOP principles
CO2	Analyze the fundamental features of Java programming language, discuss the concept of packages and understand the use of standard Java classes
CO3	Learn and implement multithreading and exception handling in Java and explain the concept of applets in Java
CO4	Design the windowed applications and web-based applications using applet and swing packages and implement event handling. Implement the Input/ Output streams and database connectivity in Java

Course Outcomes -Program Outcomes Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	3	2	2	2	2	2
CO2	3	3	3	3	3	2	3	2	2	1	1	2
CO3	3	3	2	2	2	2	3	2	1	1	1	1
CO4	3	3	2	3	3	2	3	2	1	1	1	2

UNIT 1

Introduction to Object Oriented Programming, Advantage of Object Oriented Programming, Advantage of C ++, Applications of C ++. Basic elements in C++, C++ Functions& its Prototypes: Types of Function, Actual & Formal Arguments, Default Argument, Function Overloading, Operator Overloading. Classes & Objects in C ++, Access Specifiers, Inline Member Function, Friend Function, The 'this' Keyword, Static & Non-Static Member Function, Constructors & Destructors, Array of Class Object, Union & Classes, Nested Classes, Inheritance in C++, Overriding Member Function

UNIT 2

Polymorphism in C++: Types of Polymorphism, Overloading Member & Non Member Function, Virtual& Pure Virtual Function, Abstract Class, Restriction On Using Abstract Classes. Introduction to Java: Java Architecture, Java Development Kit (JDK), Advantages of Java, Applications of Java, compilation and execution process. Basic elements in Java Programming, Classes & Objects in Java, Constructors, Class inheritance and Polymorphism in Java, Using super and final, Abstract Classes and Interfaces, Extending Interfaces, Dynamic Method Dispatch, Garbage Collection. Packages in Java: Defining a Packages, Java Class Libraries, User Defined packages. Standard Classes in Java: String, StringBuffer, StringTokenizer, Object class, System class, Wrapper Classes

UNIT 3

Exception Handling in Java: fundamentals, exception types, uncaught exceptions, throw and throws keywords, finally, built-in exceptions, user-defined exceptions. Multithreading in Java: fundamentals, Java thread model, creating threads, using methods of Thread class, thread priority, thread synchronization, Inter-thread communication: wait, notify, notify all. Applets: applet package, life cycle of an applet and security concerns, configuring applets, passing parameters to an applet

UNIT 4

Swing: Introduction to Swing, Swing Features, Hierarchy Of Java Swing Classes, Swing GUI Components, Packages Used In Swing, Using Swing API, AWT v/s Swing. Event Handling in Swings, Event Listener Interfaces, Adapter and Inner Classes, Working with windows, Graphics Object and Layout managers. Input/Output Handling in Java: Input/Output Stream, Stream Filters, Buffered Streams, Data input and Output Stream, Print Stream, File handling.

Overview of JDBC, Object serialization, Remote Method Invocation, Java Native Interfaces, Java Collection Framework

Text Books:

1. B. Stroustrup, Programming: Principles and Practice Using C++, Pearson, Second Edition, 2014
2. H. Schildt, "Java - The Complete Reference", Ninth edition, McGraw Hill Education, 2017

Reference Books:

1. G. Booch, R. Maksimchuk, M. Engle et al. Object-Oriented Analysis and Design with Applications, Third edition, Addison-wesley, 2007.
2. R. Lafore, Object Oriented Programming in C++, Fourth edition, 2008.
3. E. Balaguruswamy, Object Oriented Programming with C++, Seventh Edition, McGraw Hill Education (India), 2017.
4. P. Dietel and H. Deitel, "Java How to Program", Eleventh edition, Pearson, 2018.
5. B. Vanners, Inside the Java Virtual Machine, McGraw Hill Education, Second Edition, 1999.
6. D. Liang, Introduction to Java Programming, Seventh Edition, Pearson, 2009.
7. K, Sierra and B. Bates, Head First Java, Second Edition, O'Reilly, 2009.

Paper ID: 44602 **L** **T/P** **C**
Code: IT602 **Paper: Data Communication and Networking** **3** **1** **4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Ability to apply the basic concepts of networking and to analyse different parameters such as bandwidth, delay, throughput of the networks for the given problem
CO 2	Ability to apply different techniques to ensure the reliable and secured communication in wired and wireless communication
CO 3	Ability to analyse the networking concepts of TCP/IP for wired and wireless components. Identify the issues of Transport layer to analyse the congestion control mechanism
CO 4	Design network topology with different protocols and analyse the performance using networking tools

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	1	1	2	1	-	-	-	1
CO2	3	2	3	2	-	1	2	1	-	-	-	1
CO3	2	2	2	2	-	1	2	1	-	-	-	1
CO4	3	2	2	2	1	1	2	1	-	-	-	1

UNIT 1

Computer Networks: Introduction, Data Communications, Network and types, OSI model. TCP/IP model, LAN, WAN, MAN. Physical Link Layer: Data and Signals, Analog and digital signals, Transmission Impairment, Performance. Transmission: Digital Conversions, Analog Conversions, multiplexing, Transmission media: guided media and unguided media. switching: circuit-switched networks, packet switching

UNIT 2

Data Link Layer: Design issues, addressing. Error Detection and Correction: Types of Errors, Block Coding, Cyclic Codes, Checksum, Forward Error Correction, Data-Link Layer Protocols: Simple Protocol, Stop-and-Wait Protocol and Piggybacking, HDLC, PPP. Medium Access Control: Random Access, Controlled Access, Channelization. Wired LANs: Standard Ethernet, Fast Ethernet. Wireless LAN: Architecture, IEEE 802.11.

UNIT 3

Network Layer: Network-Layer Services, Packet Switching, Network-Layer Performance, IPV4 Addresses, Network-Layer Protocols: IP, ICMPV4, Routing Protocols: Unicast Routing Protocols: RIP, OSPF, BGP4. Congestion Control. ARP, RARP. Transport Layer: Services, Addressing, Connection establishment and release, error control and flow control, ATM Layers, Transport-Layer protocols, UDP and TCP.

UNIT 4

Application Layer: DHCP, DNS, Telnet, FTP, HTTP and SNMP. Network Security: Security goals and attacks, Ciphers. Internet Security: IPSec, Virtual Private Network (VPN). Transport Layer Security: SSL Architecture and Protocols. Firewalls: Packet-Filter Firewall, Proxy Firewall

Text Books:

1. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, Tata McGraw Hill, 2013
2. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks", 5th Edition, Pearson Education India 2013.
3. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, India, 2017
4. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Elsevier, 2012

References Books:

1. Wayne Tomasi, "Introduction to Data Communication and Networking", Pearson Education, 2005

2. James F. Kurose and Keith W.,"Computer Networking: A Top-Down Approach", 7th Edition, Pearson Education, 2017.
3. Natalia Olifer and Victor Olifer, “Computer Networks: Principles, Technologies and Protocols for Network Design”, Wiley, 2006
4. Jerry FitzGerald, Alan Dennis and Alexandra Durcikova, “Business Data Communications and Networking”, John Wiley & Sons, 2019

Paper ID: 44604		**L**	**T/P**	**C**
Code: IT604	**Paper: Operating System**	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO1	Understand the role of operating system in a computing device and scheduling of process over a processor
CO2	Ability to synchronize programs and make the system deadlock free. Ability to use concepts of semaphore and its usage in process synchronization
CO3	Ability to understand paging and segmentation methods of memory binding and their pros & cons
CO4	Ability to understand file system like file access methods, directory structures, file space allocation in disk and free space management in disk. Ability to understand disk scheduling and disk recovery procedures

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	-	1	1	-	1	1	-	-	-	-
CO2	-	1	-	1	2	-	1	1	-	-	-	-
CO3	-	1	-	1	1	-	1	1	-	-	-	-
CO4	-	1	-	1	1	-	1	1	-	-	-	-

UNIT 1

Introduction to the Operating System.Types of OS: Batch System, Time Sharing System, Real Time System, Multiuser/Single User SystemFunctions of Operating System: Process Management, Memory Management, File Management, I/O Devices Management, Information Management.

Process Management: Process concepts, Process State, Process Control Block, Context Switch, CPU Scheduling, Scheduling Criteria, Scheduling Algorithms, Pre-emptive/ Non Pre-emptive Scheduling, Threads, Thread Structure.

UNIT 2

Process Synchronisation: Critical Section Problem, Race Condition, Synchronisation Hardware, Semaphores, Classical Problems of Synchronisation.

DeadLock: Characterisation, Deadlock Prevention, Deadlock Avoidance, Detection and Recovery.

UNIT 3

Memory Management: Contiguous Allocation, External Internal Fragmentation, Paging, Segmentation, Segmentation with Paging, Virtual Memory Concept and its Implementation, Thrashing

UNIT 4

File Handling: Access Methods, Directory Structure, Allocation Methods - Contiguous Allocation, Linked Allocation, Indexed Allocation, Free Space Management.

Device Management: Disk Structure, Disk Scheduling Algorithms, Disk Management, Case study on Window and UNIX operating systems.

Text Books:

1. Silbershatz, Galvin and Gagne, "Operating Systems Concepts", Wiley, Ninth edition, 2012

Reference Books:

2. J. Archer Harris, "Operating Systems", McGraw Hill Education Private Limited, 2014
3. Flynn, Mchoes, "Understanding Operating System", Thomson Press, Third Edition, 2003
4. GodboleAhyut, "Operating System", PHI, 2003

Paper ID:44606 **L T/P C**

Code: IT606 **Paper: Software Testing and Quality Assurance** **3 1 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Understanding software quality, quality factors and standards.
CO 2	Understanding the software testing fundamentals, testing process and different verification methods.
CO 3	Ability to use the software validation techniques.
CO 4	Ability to use the agile based testing and automated testing tools.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	2	2	2	2	2
CO 2	3	3	3	3	3	2	2	3	2	2	2	2
CO 3	3	3	3	3	3	2	2	3	2	2	2	2
CO 4	3	3	3	3	3	2	2	3	3	2	2	2

UNIT 1

What is software quality, Expectations and Challenges, Software Quality Factors, Components of Software Quality Assurance System, Quality Metrics, Costs of Software Quality, Quality Management Standards, SQA unit and other actors in SQA system, Quality standards: ISO-9000, CMM, Six Sigma, Software Quality, Bad Smells in the code, Refactoring and its effects on software quality

Fundaments of software testing, The psychology of testing, testing throughout software life cycle, Terminologies: Error, Fault, Failure, Incident, Test Cases, Test Suite, Deliverables and Milestones, Software Testing Process, Developing the Test Plan, Verification, validation, Alpha, Beta and Acceptance Testing

UNIT 2

Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause-Effect Graphing Technique

Structural Testing: Control Flow Testing, Statement Coverage Branch Coverage Condition Coverage Path Coverage, Data Flow Testing, DU path, DC path, Slice Based Testing, Mutation Testing

UNIT 3

Regression Testing: Selection, Minimization and Prioritization of Test Cases for Regression Testing,Regression Testing Process,Selection of Test Cases,Regression Test Cases Selection,Reducing The Number of Test Cases,Minimization of Test Cases,Prioritization of Test Cases

Agile Testing: What is Agile Testing? Challenges, testing quadrants, creating user stories, test scenarios and test cases. Agile test automation strategy and tool (selenium) for automation

UNIT 4

Software Metrics,Characteristics of Software Metrics,Measurement Basics,Product and Process Metrics,Measurement Scale,Measuring Size,Measuring Software QualitySoftware, Quality Metrics Based on Defects,Defect Density,Phase-Based Defect Density,Defect Removal Effectiveness,Usability Metrics,Testing Metrics,OO Metrics, Some Popular OO Metric Suites,Dynamic Software Metric

Tool support for Testing, Selecting and Installing Software Testing tools. Automation and

Testing Tools - Load Runner, Win runner and Rational Testing Tools, Silk test, Java Testing Tools, JMeter, JUNIT, Selenium, and Cactus.

Text Books:

1. Daniel Galin, "Software Quality Assurance – From Theory to Implementation", Addison Wesley, Pearson Education, 2003
2. Yogesh, Singh, "Software Testing", Cambridge University Press, 2011
3. Ruchika Malhotra, Empirical Research in Software Engineering: Concepts, Analysis and Applications, CRC press, 2016

References Books:

1. William E. Perry, "Effective Methods for Software Testing", Third edition, Wiley, 2006
2. RenuRajni, Pradeep Oak, "Software Testing: Effective Methods, Tools and Techniques", McGraw Hill Education, 2004.
3. Rahul Shedye, "Software Automation Testing Tools for Beginners", Shroff Publishers, 2012.
4. K.V.K.K. Prasad, "Software Testing Tools", DreamTech Press, 2008
5. Nageswara Rao Pusuluri, "Software Testing Concepts and Tools", DreamTech Press, 2007.
6. Robert Dunn, "Software Quality Concepts and Plans", Prentice-Hall, 2003.
7. Alan Gillies, "Software Quality, Theory and Management", Chapman and Hall, 2004.
8. Naresh Chauhan, "Software Testing – Principles and Practices", Oxford University Press, 2010.
9. Jeannine M. Siviy, M. Lynn Penn, obert W. Stoddard, "CMMI and Six Sigma: Partners in Process Improvement", Pearson Education, 2007.
10. Rex Black, Erik Van Veenendaal, Dorothy Graham, "Foundation of Software Testing", ISTQB Certi fication, third Edition, Cenage learning, 2015
11. John W. Horch, "Practical Guide to Software Quality Management", second edition, Artech House, London, 2003

Paper ID: 44608 **L** **T/P** **C**
Code: IT608 **Paper: AI & Machine Learning** **3** **1** **4**

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: 75
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	Understand AI, and use state space search, heuristic search and control strategies.
CO 2	Understand and use knowledge representation, statistical reasoning.
CO 3	Understand and use fuzzy logic and genetic algorithms.
CO 4	Understand and use machine learning paradigms and neural networks.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	3	3	-	2	1	3
CO 2	3	3	3	3	3	2	3	3	-	2	1	3
CO 3	3	3	3	3	3	2	3	3	-	2	1	3
CO 4	3	3	3	3	3	2	3	3	-	2	1	3

UNIT 1

Foundations of Artificial Intelligence: AI Problems, AI Technique, criteria for success. State Space Search and control Strategies. Heuristic Search Techniques: Generate-and-Test, Hill Climbing, Best-first Search, Problem Reduction, Constraint Satisfaction, Means-ends Analysis, A* algorithm.

UNIT 2

Knowledge Representation: Representations and Mappings, Approaches and Issues in Knowledge Representation. Using Predicate Logic, Rules, Symbolic Reasoning under Uncertainty: Nonmonotonic reasoning. Statistical Reasoning: probability and Bayes theorem, certainty factors and rule-based systems, Bayesian networks, Dempster-Shafer theory. Weak slot-and-filler structures, Strong slot-and-filler structures.

UNIT 3

Fuzzy sets and fuzzy logic: Introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems. Overview of genetic algorithms.

UNIT 4

Machine learning paradigms: Introduction, machine learning systems, supervised and unsupervised learning, inductive learning, deductive learning, clustering, support vector machines, case based reasoning and learning, Artificial neural networks: Introduction, artificial networks, single layer feed forward networks, multi layered forward networks, design issues of artificial neural networks.

Text:

1. Elaine Rich, Kevin Knight and Shivashankar B Nair, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill , 2017
2. S. N. Sivanandam, S. N. Deepa, "Principles of Soft Computing", 2nd Edition, Wiley India, 2011

References:

1. Richard E. Neapolitan, Xia Jiang, "Artificial Intelligence with introduction to Machine Learning", 2nd edition , Chapman and Hall/CRC, 2018
2. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Pearson Education", 2015
3. G. A. VijayalakshmiPai, SanguthevarRajasekaran, "Neural Networks, Fuzzy Logic And Genetic Algorithm: Synthesis And Applications", 2nd Edition, PHI Learning, 2017

Paper ID: 44626 **L T/P C**

Code: IT626 Paper: Human Values and Professional Ethics (NUES) **2 0 2**

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: 75
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	Ability of students to understand the intentions of everyone to live in Harmony and Happiness by understanding the meaning of Natural acceptance in practical scenario
CO 2	Ability of students to become more aware of themselves and their surroundings (family) with right understanding
CO 3	Ability of students in understanding their commitment towards (human values, human relationship and human society) undivided society and nature.
CO 4	To apply what they have learnt to their own self in different day-to-day settings in real life and their professional development

CO-PO Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	3	-	3	3	3	1
CO2	-	-	-	-	-	-	3	-	3	3	3	1
CO3	-	-	-	-	-	-	3	-	3	3	3	1
CO4	-	-	-	-	-	-	3	-	3	3	3	1

UNIT 1

Value Education-Need, development, basic guidelines, content and process. Self-Exploration-what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Basic human aspirations- Continuous Happiness and Prosperity, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Happiness and Prosperity - A critical appraisal of the current scenario. Method to fulfil the above human aspirations, development of human consciousness, holistic development, Role of education-sanskar.

UNIT 2

Understanding happiness and prosperity (various levels)- Human body as co-existence of Self and body, Harmony in the Self , Harmony of self with body- 'I' (I being the doer, seer and enjoyer), the characteristics and activities of 'I', Self-regulation and health (nurturing, protecting and right utilisation). Understanding Harmony in the Family- Harmony in Human-Human Relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Difference between intention and competence, Respect as right evaluation, Affection, Care, Guidance, Reverence, Glory and Gratitude, Love as complete value (right feeling)

UNIT 3

Understanding Harmony in the Society, Nature and Existence – Human goal (Dimensions), Human order, Harmony from family order to world, Family order, Universal Human order, Natural outcome of right understanding (Self role and participation in society). Harmony in nature -Nature as collection of units, classification of Units into four orders (Activity, innateness, Natural characteristics and inheritance), interconnectedness, mutual fulfilment among four orders, Abundance in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence. Human being as cause of imbalance in nature, pollution, depletion of resources and role of technology etc.

UNIT 4

Ethical Human conduct- Implications of the above Holistic Understanding of Harmony on Professional Ethics. Definitiveness of ethical human conduct, Development of Human consciousness. Professional ethics in light of right understanding-Profession in context with comprehensive Human Goal, Ethical competence-salient features, Issues in Professional ethics-current scenario, Prevailing approaches towards promotion of professional ethics-Inadequacy, Inherent contradictions and Dilemmas.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, "Human Values and Professional Ethics " Excel Books, New Delhi, 2010

Reference books:

1. A.N. Tripathi, "Human Values" New Age Intl. Publishers, New Delhi, 2004
2. A Nagaraj, JeevanVidyaPrakashan, "JeevanVidya: EkParichaya," Amarkantak, 1999
3. Mohandas Karamchand Gandhi, "Mahatma Gandhi Autobiography: The Story Of My Experiments With Truth" 2009
4. Jayshree Suresh (Author), B S Raghavan, "Human Values and Professional Ethics", 3rd edition, S Chand Publications, 2003.
5. R S nagarajan, "A Text book on Professional ethics and Human values", New Age Intl. Publishers, New Delhi, 2nd edition, 2019.
6. M. Govindarajan (Author), S. Senthilkumar (Author), M.S. Natarajanv , "Professional Ethics and Human Values", PHI, 2013.

Paper ID: 44610 **L** **T/P** **C**

Code: IT610 **Paper: Software Requirement and Estimation** **4** **04**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.

2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Ability to understand the concept, process and the types of software requirement
CO 2	Ability to model different requirements through various modelling diagrams and the requirements validation process
CO 3	Ability to analyse the requirements and estimation of the software accordingly
CO 4	To get equipped with the knowledge of estimation methods along with practical implications through some case studies

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	3	-	3	2	-	-	2	1
CO 2	3	3	3	3	3	-	3	2	-	-	2	1
CO 3	3	3	3	3	3	-	3	2	-	-	2	1
CO 4	3	3	3	3	3	-	3	2	-	-	2	1

UNIT 1

Software Requirement Fundamentals: Definition of Software Requirement, Good Practices for Requirements Engineering, Identifying Requirements, Product and Process Requirements, Improving Requirements Processes, Functional and Non-Functional Requirements, Quantifiable Requirements, System Requirement and Software Requirements.

Requirements elicitation: Elicitation techniques, setting requirements priorities, Requirements attributes, Internal and external quality attributes, Quality attribute trade-offs, Implementing quality attribute requirements, Requirements management Principles and practices, Change Management Process, Requirements Traceability Matrix, Informal and formal requirements specification languages: syntactic and lexical elements.

UNIT 2

Requirements Analysis: Requirement Analysis Documentation, Review, Requirements Classification, Conceptual Modeling, Analysis Models, Architectural Design and Requirements Allocation, Requirements Negotiation, Software requirements and risk management, Risk reduction through prototyping, System Requirements Specification (SRS creation), System Definition Document (SDD creation)

Requirements Validation: Setting requirement priorities, Verifying Requirement Quality, Requirements Reviews, Prototyping, Testing the requirements, Model Validation, Acceptance Tests, Practical Considerations: Iterative Nature of the Requirements Process,

Tools for Requirements Management and Estimation: Benefits, commercial requirements management tool, Rational Requisite pro, Caliber – RM, implementing requirements management automation.

UNIT 3

Software Estimation: Components of Software Estimations, Software Pricing Factors, Estimation methods: Algorithmic cost modelling, Expert judgement, Estimation by analogy, Parkinson's Law, Pricing to win, Delphi Technique, Work Breakdown Structure (WBS), Three Point Estimation, Problems associated with estimation, Key project factors that influence estimation Size Estimation.

UNIT 4

Effort, Schedule and Cost Estimation: Productivity, Estimation Factors, Approaches to Effort and Schedule Estimation, Function Point Analysis, Object point Analysis, Mark II FPA, Full Function Points, LOC Estimation, Conversion between size measures, FP counting using case study from DFD, review of COCOMO I, COCOMO II, Putnam Estimation Model, Algorithmic models, Cost Estimation

Six Forms Of Software Cost Estimation, Software Cost-Estimating Tools And Project Success And Failure Rates, Sources Of Error In Software Cost Estimation, Cost-Estimating Adjustment Factors, Activity-Based Software Cost

Estimating, Software Estimation Tools: Desirable Features In Software Estimation Tools, IFPUG, USC's Cocomo II, Slim (Software Life Cycle Management) Tools.

Text Books:

1. "Software Engineering Body of Knowledge (SWEBOK)", IEEE Computer Society.
2. Karl E. Weigers, Joy Beatty, "Software Requirements", 3rd Edition, Microsoft Press, 2003.
3. Capers Jones, "Estimating Software Costs: Bringing Realism to Estimating", McGraw Hill Professional, 2007

References Books:

1. Swapna Kishore and Rajesh Naik, "Software Requirements and Estimation", Tata Mc Graw Hill, 2001.
2. Richard D. Stutzke, "Estimating Software-Intensive Systems: Projects, Products, and Processes", Addison-Wesley Professional; 1st Edition, 2005
3. M. A. Parthasarathy, "Practical Software Estimation: Function Point Methods for Insourced and Outsourced Projects", Addison-Wesley Professional, 2007

Paper ID: 44628 **L T/P C**

Code: IT628 **Paper: Computer Graphics & Multimedia** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	Understand and use raster graphics algorithms and geometric transformations.
CO 2	Understand the concept of imparting realism in the models.
CO 3	Ability to use rendering techniques and algorithms
CO 4	Ability to use multimedia and encoding techniques used in data compression

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	3	2	3	3	3	-	3	2	2	2
CO 2	3	2	3	2	3	3	3	-	3	2	2	2
CO 3	3	2	3	2	3	3	3	-	3	2	2	2
CO 4	3	2	3	2	3	3	3	-	3	2	2	2

UNIT 1

Basic raster graphics algorithms for drawing 2 D Primitives liner, circles, ellipses, clipping of point, line and polygon, Polygon filling algorithm. Meshes in 3D, Geometric Transformation: 2D, 3Dtransformations, window to view port transformations, Graphics Hardware: Hardcopy & display techniques, Input devices, image scanners

UNIT 2

Modelling types: Wireframe, surface and solid modelling. Generation of curves Curve, surfaces, Introduction to NURBS. aromatic and colour models: Hardware and software models. Shading Techniques: flat, Gouraud&Phong shading techniques. Illumination models

UNIT III

Visible surface determination techniques: Z-Buffer algorithm, A Buffer algorithm. Implementation of scan line algorithm, area subdivision algorithm for visible surfaces, Rendering: Hardware rendering and software rendering. Ray casting, ray-tracing, recursive ray tracing rendering algorithms.

UNIT 4

Introduction: Concept of Multimedia, Media& data stream, main properties of multimedia system, Data stream characteristics for continuous media Multimedia Applications, Hardware & Software requirements of multimedia product development cycle. Compression Techniques: Lossless and Lossy compression, differential coding, run length coding, Statistical Coding, Transform Coding, Text compression: static Huffman technique, Dynamic Huffmann Technique.

Text Books:

1. Fred Halsall "Multimedia Communications- Applications, Networks, Protocols & Standards', Pear -son Publication, 2018.
2. Foley et. al., "Computer Graphics Principles & practice", Addison Wesley Ltd., 2003.

References Books:

1. David Hillman, "Multimedia Technology & Applications", Galgotia Publications,1997.
2. Andleigh and Thakarar "Multimedia System Design" PHI Reference, 2012.
3. Nigel Chapman & Jenny Ch-apman, "Digital Multimedia", 3rd edition, Publications, 2009.
4. D.P. Mukherjee, "Fundamentals of Computer Graphics and Multimedia", PHI, 2004
5. R.H. Bartels, J.C. Beatty and B.A. Barsky, "An Introduction to Splines for use in Computer Graphics and Geometric Modeling", Morgan Kaufmann Publishers Inc., 1987.

6. D. Hearn and P. Baker, "Computer Graphics", Prentice Hall, 1986
7. W. Newman and R. Sproul, "Principles of Interactive Computer Graphics, McGraw-Hill, 1973.

Paper ID: 44614 **L** **T/P** **C**
Code: IT614 **Paper: Internet of Things** **4** **0** **4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	To introduce the terminology, technology and its applications. M2M (machine to machine) with necessary protocols
CO 2	To introduce the Python Scripting Language which is used in many IoT devices
CO 3	To introduce the Raspberry PI platform, that is widely used in IoT applications
CO 4	To introduce the implementation of web-based services on IoT devices

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	-	1	-	1	1	-	1	1	-	-	-	-
CO 2	-	1	-	1	2	-	1	1	-	-	-	-
CO 3	-	1	-	1	1	-	1	1	-	-	-	-
CO 4	-	1	-	1	1	-	1	1	-	-	-	-

UNIT 1

Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

UNIT 2

IoT and M2M – Software defined networks, network function virtualization, difference between SDN and NFV for IoT. Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

UNIT 3

Introduction to Python - Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib

UNIT 4

IoT Physical Devices and Endpoints - Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins. IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API.

Text Books:

1. ArshdeepBahga and Vijay Madisetti ,"Internet of Things - A Hands-on Approach" , Universities Press, 2015, ISBN: 9788173719547
2. Matt Richardson & Shawn Wallace ,"Getting Started with Raspberry Pi", O'Reilly (SPD), 2014, ISBN: 9789350239759

References Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

Paper ID: 44616 **L** **T/P** **C**
Code: IT616 **Paper: Theory of Computation** **4** **0** **4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Understand the design aspects of "abstract models" of computers like finite automata, pushdown automata, and Turing machines.
CO 2	Comprehend the recognizability (decidability) of grammar (language) with specific characteristics through these abstract models.
CO 3	Decide what makes some problems computationally hard and others easy.
CO 4	Deliberate the problems that can be solved by computers and the ones that cannot.

Course Outcomes -Program Outcomes Matrix
Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	1	2	2	-	-	-	-	-	-	-
CO 2	3	3	1	2	2	-	-	-	-	-	-	-
CO 3	3	3	1	2	1	-	-	-	-	-	-	-
CO 4	3	3	1	2	1	-	-	-	-	-	-	-

UNIT 1
Automata and Language Theory: Chomsky Classification, Finite Automata, Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), Regular Expressions, Equivalence of DFAs, NFAs and Regular Expressions, Closure properties of Regular grammar, Non-Regular Languages, Pumping Lemma.
UNIT 2
ConText Books Free Languages: Context Free Grammar (CFG), Parse Trees, Push Down Automata (deterministic and non-deterministic) (PDA), Equivalence of CFGs and PDAs, Closure properties of CFLs, Pumping Lemma, Parsing, LL(K) grammar.
UNIT 3
Turing Machines and Computability Theory: Definition, design and extensions of Turing Machine, Equivalence of various Turing Machine Formalisms, Church – Turing Thesis, Decidability, Halting Problem, Reducibility and its use in proving undecidability. Rices theorem. Undecidability of Posts correspondence problem.
UNIT 4
Complexity Theory: The class P as consensus class of tractable sets. Classes NP, co-NP. Polynomial time reductions. NP-completeness, NP-hardness. Cook- Levin theorem (With proof). Space complexity, PSPACE and NPSPACE complexity classes, Savitch theorem (With proof). Probabilistic computation.
Text Books:
1. J. Hopcroft, R. Motwani, and J. Ullman, "Introduction to Automata Theory, Language and Computation", 2nd Ed, Pearson, 2006.
References Books:
1. Peter Linz, "An Introduction to Formal Languages and Automata", 6th edition, Viva Books, 2017
2. Maxim Mozgovoy, "Algorithms, Languages, Automata, and Compilers", Jones and Bartlett, 2010.
3. D. Cohen, "Introduction to Computer Theory, 2nd Edition, Wiley, N. York, 1996.
4. J. C. Martin, "Introduction to Languages and the Theory of Computation", 2nd Edition, TMH, 2003.
5. K. L. Mishra and N. Chandrasekharan, "Theory of Computer Science: Automata, Languages and Computation", PHI, 2006.

Paper ID: 44618 **L** **T/P** **C**

Code: IT618 **Paper: Optimization Techniques** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	To introduce various single variable optimization techniques
CO 2	To understand optimization methods for multivariable
CO 3	To explain the concept of constrained optimization algorithms
CO 4	To help in understanding optimization algorithms, genetic algorithms, simulated annealing

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	1	-	2	2	-	-	1	1
CO 2	3	3	3	3	1	-	2	2	-	-	1	1
CO 3	3	3	3	3	1	-	2	2	-	-	1	1
CO 4	3	3	3	3	1	-	2	2	-	-	1	1

UNIT 1

Introduction: Optimal Problem Formulation, Engineering Optimization Problems, Classification of Optimization Algorithms. Single-variable Optimization Algorithms: Optimality Criteria, Bracketing Methods, Region-Elimination Methods, Point-Estimation Method, Gradient-based Methods, Root-finding using Optimization Techniques.

UNIT 2

Multivariable Optimization Algorithms: Optimality Criteria, Unidirectional Search, Direct Search Methods, Gradient-based Methods.

UNIT 3

Constrained Optimization Algorithms: Kuhn-tucker conditions, Lagrangian Duality Theory, Transformation Methods, Sensitivity Analysis, Direct Search for Constrained Minimization, Linearized Search Techniques, Feasible Direction Method, Quadratic Programming, Generalized Reduced Gradient Method, Gradient Projection Method.

UNIT 4

Specialized Algorithms: Integer Programming, Geometric Programming. Non-traditional Optimization Algorithm: Genetic Algorithms, Simulated Annealing, Global Optimization

Text Books:

1. KalyanmoyDeb , "Optimization for Engineering Design", PHI ,2012

References Books:

1. S. S.Rao ,"Engineering optimization: Theory and practice", , 4th Edition , Wiley, 2013.
2. Ashok D.Belegundu and Tirupathi R Chandrupatla , "Optimization Concepts and Applications in Engineering", , 2nd Edition, Cambridge University Press, 2011.
3. H.A. Taha ,"Operations Research : An Introduction", 10th edition, Pearson Education, 2019

Paper ID: 44620 **L T/P C**
Code:IT620 **Paper: Front End Design Techniques** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	Ability of students to understand the concepts of HTTP and HTML Language
CO 2	Ability of students to understand the concepts of XML and JavaBean
CO 3	Ability of students to understand the concepts of Servlet and JSP
CO 4	Ability of students to understand concept of JDBC

Course Outcomes -Program Outcomes Matrix
Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO 1	3	3	3	3	3	3	3	3	2	2	2	1
CO 2	3	3	3	3	2	2	3	2	1	1	1	1
CO 3	3	3	2	2	2	3	3	3	2	1	1	1
CO 4	3	3	2	3	2	2	3	2	1	1	1	1

UNIT 1

History of the Internet and World Wide Web – HTTP, SMTP, MIME, HTML Common tags- List, Tables, images, forms, Frames; Cascading Style sheets, Introduction to Java Scripts, Objects in Java Script, Dynamic HTML with Java Script. Introduction to BootStrap and MEAN Stack

UNIT 2

XML: Document type definition, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM.

Java Beans: Introduction to Java Beans, Advantages of Java Beans, BDK , Introspection, Using Bound properties, Bean Info Interface, Java Beans API, Introduction to EJB's.

UNIT 3

Web Servers and Servlets: Tomcat web server, Introduction to Servlets: Lifecycle of a Servlets, The ServletsAPI, The javax.servelet Package, Reading Servelet parameters, Reading Initialization parameters. The javax.servelet HTTP package, Handling Http Request & Responses, Using Cookies-Session Tracking, Security Issues;

Introduction to JSP: The Anatomy of a JSP Page. JSP Application Design with MVC , JSP Application Development: Generating Dynamic Content, Using Scripting Elements Implicit JSP Objects, Conditional Processing Sharing Session.

UNIT 4

Database Access : Database Programming using JDBC, Studying Javax.sql.* package, Accessing a Database from a JSP Page, Application – Specific Database Actions, Statement and Prepared Statement Interface.

Text Books:

1. Deitel&Deitel, Goldberg, "Internet and world wide web – How to Program", 5th Edition, Pearson Education, 2011.
2. Patrick Carey, "New Perspectives on HTML, CSS, and XML, Comprehensive"., 4th Edition, PHI, ,2013
3. Hans Bergsten ,"Java Server Pages ", SPD O'Reilly, 2003.

References Books :

1. Patrick Naughton and Herbert Schildt , "The 2 Complete Reference" Fifth Edition ,TMH, 2002
2. Chris Bates ,"Web Programming, building internet applications", 2nd edition, WILEY Dreamtech, 2006

Paper ID: 44622 **L T/P C**
Code: IT622 **Paper: Simulation and Modelling** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	Ability to apply functional modeling method to model the activities of a static system
CO 2	Ability to describe and develop equivalent model for a dynamic process.
CO 3	Ability to calibrate and validate developed simulation.
CO 4	To develop basic understanding for developing simulation for complex scenarios [systems]

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	3	2	-	-	-	-	-	-	-
CO 2	3	3	2	2	3	-	-	-	-	-	-	-
CO 3	3	2	2	2	2	-	-	-	-	-	-	-
CO 4	3	3	2	3	2	-	-	-	-	-	-	-

UNIT-1

Simulation overview: Applicability of simulation as a tool, Advantages and disadvantages of Simulation; Areas of application, Systems and system environment; Components of a system; Discrete and continuous systems, Model of a system; Types of Models, Discrete-Event System Simulation Simulation examples: Simulation of queuing systems. General Principles.

UNIT 2

Statistical Models in Simulation: Discrete distributions. Continuous distributions,Poisson process, Empirical distributions. Queuing Models:Characteristics of queuing systems,Queuing notation,Long-run measures of performance of queuing systems, Networks of queues, Generation of Random and pseudo-random numbers, Techniques and tests for random numbers

UNIT 3

Input modelling: Data Collection; Identifying the distribution with data, Parameter estimation, Goodness of Fit Tests, Fitting a non-stationary Poisson process, Selecting input models without data, Multivariate and Time-Series input models. Estimation of Absolute Performance: Types of simulations with respect to output analysis,Stochastic nature of output data, Measures of performance and their estimation.

UNIT 4

Output analysis: Output analysis for terminating simulations and steady-state simulations. Verification, Calibration And Validation: Optimization: Model building, verification and validation, Verification of simulation models, Verification of simulation models, Calibration and validation of models, Optimization via Simulation.

Text Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, "Discrete-Event System Simulation", 5th Edition, Pearson Education.

References Books:

1. Averill M. Law" Simulation Modeling and Analysis", 4th Edition, Tata McGraw-Hill, 2007
2. Geofrey Gordon, "System Simulation ", 2nd Edition , Pearson Education.

Paper ID:44624		**L**	**T/P**	**C**
Code: IT624	**Paper: Mobile Computing**	**34**	**0**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Be able to understand the concepts of Mobile Computing
CO 2	To be able to understand the concept of different generations of Wireless Networks
CO 3	To be able to understand the concept of Bluetooth Technology, WPAN, WBAN.
CO 4	To be able to understand the concept of Smart Objects

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	3	2	3	2	3	2	1	3	2	1
CO 2	3	2	2	3	3	3	3	2	2	3	2	1
CO 3	3	3	3	3	3	2	3	2	3	2	2	1
CO 4	3	2	2	2	3	3	3	2	1	2	2	1

UNIT 1

Fundamentals of Mobile Computing: Evolution of mobile computing services, Introduction to Personal Communication Services (PCS) architecture, The Cellular Network Concept and Design, Networks signalling, , frequency reuse, handoff & Mobility management, Improving coverage and capacity in cellular networks: sectoring, cell splitting.

UNIT 2

Generations of Mobile Computing Networks: Overview of 1G, 2G, 2.5G, 3G, 4G and 5G, Architecture and working principle: GSM - GPRS -digital cellular standard - Third Generation (3G) Mobile Services: Introduction to Universal Mobile Telecommunication Systems (UMTS), IMT-2000 , 4G-LTE, Introduction to 5G.

UNIT 3

Low Range Mobile Computing Networks: Wireless LANs, IEEE 802.11 (wi-fi) Architecture and Protocol layers, Wireless Personal area Networks (WPAN): Blue tooth Technology, IEEE 802.15 protocol stack; Wireless Body Area Network (WBAN), ZIGBEE: Standard and architecture.

UNIT 4

Use Cases of Mobile Computing: Smart Homes, Smart Agriculture, Smart TV, Wearable Devices: Smart Watches, Health Monitoring

Text Books:

1. Jochen Schiller, "Mobile Communications," 2nd Edition, Pearson Education Pvt. Ltd., 2018.
2. Raj Kamal," Mobile Computing", 2nd edition, Oxford University Press, 2014.
3. Koushik Sinha, Sasthi C. Ghosh, B.P. Sinha, "Wireless Networks and Mobile Computing", CRC Press, 2016

References Books:

1. Sunilkumar S., Manvi M., S. Kakkasageri "Wireless and Mobile Networks, Concepts and Protocols", 2nd edition, John Wiley & sons, 2016.
2. Amitabh Ghosh and RapeepatRatasuk, "Essentials of LTE and LTE-A," Cambridge University Press, 2011.
3. Clint Smith and Daniel Collins, "3G Wireless Networks", 2nd Edition, Tata McGraw Hill, 2007.
4. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley 2015.

Paper ID:44701 **L T/P C**

Code: IT701 **Paper: Data Analytics** **3 1 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	To be able to understand the data mining fundamentals
CO 2	To be able to have good understanding of Data and data pre processing
CO 3	To have knowledge Data warehousing and OLAP.
CO 4	To have knowledge of different types of data mining techniques.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	-	2	-	1	-	-	-	1	-
CO 2	3	3	3	-	2	-	1	-	-	-	1	-
CO 3	3	3	3	-	2	-	1	-	-	-	1	-
CO 4	3	3	3	-	2	-	1	-	-	-	1	-

UNIT 1

Data and Information,What Is Data Mining, Kinds of Data Can Be Mined: Database Data,Data Warehouses,Transactional Data,Other Kinds of Data, Getting to Know Your Data: Data Objects and Attribute Types: Nominal Attributes,Binary Attributes,Ordinal Attributes,Numeric Attributes,Discrete versus Continuous Attributes,Basic Statistical Descriptions of Data:Measuring the Central Tendency: Mean, Median, and Mode.

Measuring the Dispersion of Data: Range, Quartiles, Variance,Standard Deviation, and Interquartile Range. Graphic Displays of Basic Statistical Descriptions of Data, Data Visualization:Pixel-Oriented Visualization Techniques,Geometric Projection Visualization Techniques,Icon-Based Visualization Techniques,Hierarchical Visualization Techniques ,Visualizing Complex Data and Relations

Measuring Data Similarity and Dissimilarity :Data Matrix versus Dissimilarity Matrix ,Proximity Measures for Nominal Attributes ,Proximity Measures for Binary Attributes ,Dissimilarity of Numeric Data: Minkowski Distance ,Proximity Measures for Ordinal Attributes ,Dissimilarity for Attributes of Mixed Types .Cosine Similarity

UNIT 2

Data Preprocessing :Data Quality: Why Preprocess the Data?,Major Tasks in Data Preprocessing

Data Cleaning :Missing Values,Noisy Data ,Data Cleaning as a Process ,Data Integration :Entity Identification Problem ,Redundancy and Correlation Analysis,TupleDuplication,Data Value Conflict Detection and Resolution,Data Reduction:Overview of Data Reduction Strategies, Regression and Log-Linear Models: Parametric Data Reduction,Sampling,Data Transformation and Data Discretization:Data Transformation Strategies Overview,Data Transformation by Normalization,Discretization by Cluster, Decision Tree, and Correlation Analyses, Concept Hierarchy Generation for Nominal Data

UNIT 3

DataWarehousing and Online Analytical Processing: DataWarehouse Basic Concepts, Differences between Operational Database Systems and Data Warehouses,Data Warehousing: A Multitiered , Data Warehouse Models: Enterprise Warehouse, Data Mart, and Virtual Warehouse , Extraction, Transformation, and Loading, Metadata Repository,DataWarehouse Modeling: Data Cube and OLAP,A Multidimensional Data Model,

Stars, Snowflakes, and Fact Constellations: Schemas for Multidimensional Data Models, Dimensions: The Role of Concept Hierarchies

UNIT 4

Mining Frequent Patterns, Associations, and Correlations:Market Basket Analysis: A Motivating , Frequent Itemsets, Closed Itemsets, and Association Rules , Frequent Itemset Mining Method Apriori Algorithm, Classification: Basic Concepts , Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, Model Evaluation and Selection, Metrics for Evaluating Classifier Performance. Concepts and Mechanisms,Training Bayesian Belief Networks, Classification by Backpropagation, Support Vector Machines: The Case When the Data Are Linearly Separable,The Case When the Data Are Linearly Inseparable

Cluster Analysis: Basic Concepts and Methods:Partitioning Methods, Hierarchical Methods: Density-Based Methods,Grid-Based Methods, Evaluation of Clustering, Determining the Number of Clusters, Measuring Clustering Quality, Basics of Mining Complex Data Types, Other Methodologies of Data Mining, Data Mining Applications

Text Books:

1.J.Han, M.Kamber, "Data Mining: Concepts and Techniques", Academic Press, Morgan Kaufmann Publishers, 2001.

2. C.S.R. Prabhu, "Data Ware housing: Concepts, Techniques, Products and Applications", Prentice Hallof India, 2001.

3. D.T.Larose and C.D.Larose, "Data Mining and Predictive Analysis, John Wiley& Sons, 2015.

References Books:

1. Tom Mitchell, "Machine Learning, McGraw-Hill", 1997.

2. EthemAlpaydin, "Introduction to Machine Learning", MIT Press,2014.

Paper ID: 44703 **L T/P C**

Code: IT703 **Paper: Software Project Management** **3 1 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	Develop a basic understanding of problems associated with software project management.
CO 2	Understand various stages of project development and the techniques used for project planning.
CO 3	Understand risk management and change control management
CO 4	Gain an insight to measurement of project progress and effectively implement the project plans using various software project management tools.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	2	1	1	-	1	1	-	-	1	1
CO 2	3	3	3	3	2	1	1	2	1	1	1	1
CO 3	2	3	2	1	2	-	2	2	-	1	1	1
CO 4	2	3	2	3	1	-	2	3	1	-	2	1

UNIT 1

Importance of software project management What is a project? Problems with Software Projects What is Project Management? Stakeholders in software project; Stages of Project, The Feasibility Study, The Cost benefit Analysis , Cost-benefit evaluation techniques; Cash flow forecasting

UNIT 2

Steps in project initiation, Business Case, Project Charter, Steps in project planning; Team Contract, Defining scope and objectives; work breakdown structure; Deliverables and other products; time, cost, and resource estimation.

UNIT 3

Activity planning, Network planning model; Activity-on-arrow network; Precedence network; Forward pass; Backward pass; Critical path; Slack and float.

UNIT 4

Nature and categories of risk in software development; risk Identification; Risk assessment; Risk mitigation, monitoring, and management; Evaluating schedule risk using PERT. Measurement of physical and financial progress; Earned value analysis; Status reports; Milestone reports; Change control, Project closing, Lesson Learned report

Text Books:

1. Bob Hughes and Mike Cotterell, "Software Project Management", Third Edition 2002, McGraw-Hill
2. Kathy Schwalbe, "Information Technology Project Management", Fifth edition, 2008, Thomson learning

References Books:

1. Pankaj Jalote,"Software Project Management in Practice", Addison-Wesley.
2. Robert T. Futrell, Donald F. Shafer, and Linda I. Shafer, "Quality Software Project Management", Pearson Education, 2002
3. Walker Royce, Software Project Management, Addison-Wesley, 1998.
4. Clements and Gido, "Effective Project Management", Cengage Learning, 2012.
5. MuraliChemuturi, Thomas Cagley, "Mastering Software Project Management: Best Practices, Tools and Techniques", J. Ross Publishing, 2010.
6. Roger S. Pressman, "Software Engineering: A practitioner's Approach", 8th Edition, McGraw-Hill , 2019

Paper ID: 44705 **L T/P C**

Code: IT705 **Paper: Mobile Architecture and Programming** **3 1 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	Ability of students to understand the concepts of Mobile Services Architecture
CO 2	Ability of students to understand concept of Context Awareness and Management and Multimo-dality and Personalization
CO 3	Ability of students to understand concept of Service-Oriented Architecture for Mobile Services.
CO 4	Ability of students to understand concept of Service Discovery for Mobile Computing and Mobile Agents for Mobile Services

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	3	3	3	3	3	2	3	2	2	1
CO2	3	3	3	3	3	1	3	1	-	-	2	2
CO3	3	3	3	2	2	2	3	3	2	1	-	-
CO4	3	3	3	3	2	3	2	1	1	1	-	1

UNIT 1

Users, Applications and Services and User Centricity: Mobility Services Architecture: Requirements and Hurdles; Mobile Services Reference Model; Functions and Interfaces; Mobile Services Architecture: Functional Components Interworking, Architecture Stability; Collaborative User Centric Design Process

UNIT 2

Context Awareness and Management: Context Management Framework, Context Gathering and Simulation, Machine Learning for Context Awareness. Multimodality and Personalization: Contextual Personalization; Multimodal Interfaces in Mobile Environments; Privacy, Trust and Group Communications: Group Awareness Function; Privacy and Trust. Brief Overview of Trials and Evaluation for Acceptance

UNIT 3

Service-Oriented Architecture for Mobile Services: Why SOC/SOA for Mobile Services?Architectural Styles and Protocols for Mobile Web Service; Mobile Web Services Programming Support;Real-World SOA Mobile Services; SOA/Web Services and Other Technologies/Styles for Mobile Services.

UNIT 4

Service Discovery for Mobile Computing—Classifications, Considerations, and Challenges; Introduction; Classifications of Service Discovery Frame works; Considerations of Service Discovery for Mobile Computing; Mobile Agents for Mobile Services : Agents and the Services Offered by Agents, Mobile Agent Technology, Application Domains, Mobile Computing with Mobile Agents, Disconnected Operation, Heterogeneous Environment Integration, Distributed Computing, Agent Security Development, Mobile App development Platforms: Introduction to Mobile OS: e.g. Andriod, iOS, Embedded Linux, Windows Mobile, Windows Phone, Mobile Application Development Languages: Introduction to HTML5, Java2 ME (latest version), BREW

Text Books :

1. Klemettinen, Mika, "Enabling technologies for mobile services: theMobiLife", John Wiley & Sons, 2007
2. Kumar, Anup, and Bin Xie, "Handbook of Mobile Systems Applications and Services" CRC Press, 2016.

References Books:

1. Le Bodic, Gwenael ,"Mobile messaging technologies and services: SMS, EMS and MMS" John Wiley & Sons, 2005.

2. Kim, Jieun, Yongtae Park, Chulhyun Kim, and Hakyeon Lee, "Mobile application service networks: Apple's App Store." Service Business 8, no. 1, 1-27, 2014.
3. DT Editorial Services , "HTML 5 Black Book ", 2nd Edition , Dreamtech Press, 2016.
4. Pradeep Kothari, "Android Application Development (With Kitkat Support)" , Dreamtech Press, 2014
5. Barry Burd, "Android Application Development All-In-One for Dummies", John Wiley, Second edition, 2015
6. Jesse Feiler, "iOS App Development for Dummies", John Wiley, 2014

Paper ID: 44707 **L T/P C**

Code: IT707 **Paper: Design Patterns** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks:75**
1. 1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
3. 2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	To be able to understand the need for design pattern
CO 2	To be able to differentiate between creational pattern and structural pattern
CO 3	To have a knowledge of behavioural pattern
CO 4	To have basic knowledge of Mediator, Observe, Strategy and Anti-Patterns

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	1	2	-	1	2	3	-	1	-
CO 2	3	3	3	1	3	-	1	2	3	-	1	-
CO 3	3	3	3	1	3	-	1	2	3	-	1	-
CO 4	3	3	3	1	3	-	1	2	3	-	1	-

UNIT 1

Overview of Design Patterns. The Catalog of Design Patterns, Organizing the Catalog, using Design Patterns to solve design Problems, How to Select and use a Design Pattern. Issues on the relevance of design patterns in the context of different programming languages.

UNIT 2

Creational Patterns: Overview of Creational Patterns. Implementations of Abstract Factory, Builder, Factory Method, Prototype, and Singleton design patterns. Structural Pattern: Overview of Structural patterns. Implementations of Adapter, Bridge, and Composite design patterns.

UNIT 3

More on Structural Patterns: Implementations of Decorator, façade, Flyweight, and Proxy Design patterns. Behavioral Patterns: Overview of behavioral patterns. Implementations of Command, Interpreter, Iterator Design patterns.

UNIT 4

More on Behavioral Patterns: Implementations of Mediator, Observer, Strategy, Visitor design patterns. Anti-patterns. SOLID principles of good object oriented design. What to Expect from Design Patterns, Case study.

Text Books:

1. Erich Gamma, Richard Helm , Ralph Johnson and John Vlissidess," Design Patterns: Elements of Reusable Object-Oriented Software", 1st Edition, Pearson Education, 2015

References Books:

1. Eric Freeman, Elisabeth Robson, Bert Bates, Kathy Sierra, "Head First Design Patterns", O'Reilly Media, Inc, 2004.

2. Martin Fowler, " Patterns of Enterprise Application Architecture", Addison Wesley, 2002

3. Alan Shalloway, James R. Trott, "Design Patterns Explained: A New Perspective on Object-Oriented Design", 2nd edition, Addison Wesley, 2004

4. Craig Larman, "Applying UML and Patterns", Pearson, 2015

Paper ID: 44709 **L T/P C**

Code: IT709 **Paper: Compiler Design** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Understanding of concepts, techniques, and different phases used for developing a simple language compiler.
CO 2	Specify and analyze the lexical, syntactic and semantic structures of advanced language features.
CO 3	Separate the lexical, syntactic and semantic analysis into meaningful phases for a compiler to undertake language translation.
CO 4	Developing foundations to design a scanner, parser, and semantic analyser

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	-	-	-	-
CO 2	3	2	2	2	2	-	-	-	-	-	-	-
CO 3	3	2	2	2	1	-	-	-	-	-	-	-
CO 4	3	2	1	2	1	-	-	-	-	-	-	-

UNIT 1

Compiler Structure: Analysis-synthesis model of compilation, various phases of a compiler, tool based approach to compiler construction. Lexical analysis: Interface with input parser and symbol table, token, lexeme and patterns, difficulties in lexical analysis, error reporting and implementation. Regular grammar & Regular Expression.

UNIT 2

Syntax Analysis: Context free grammars, ambiguity, associability, precedence, top down parsing, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing LL(1) grammar, Bottom up parsing, operator precedence grammars, LR parsers (SLR, LALR, LR).

UNIT 3

Syntax directed definitions: Inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions. Type checking, Run time system: storage organization, activation tree, activation record, parameter passing symbol table, dynamic storage allocation. Intermediate code generation: intermediate representation, translation of declarations, assignments, Intermediate Code generation for control flow, Boolean expressions and procedure calls, implementation issues.

UNIT 4

Code generation and instruction selection: Issues, basic blocks and flow graphs, register allocation, code generation, DAG representation of programs, code generation from DAGS, peep hole optimisation, code generator generators, specification of machine. Code optimization: source of optimizations, optimization of basic blocks, loops, global dataflow analysis, solution to iterative dataflow equations, code improving transformations, dealing with aliases, data flow analysis of structured flow graphs.

Text Books:

1. K. C. Louden, "Compiler Construction, Principle and Practice" Thomson Books, 2006
2. Alfred V. Aho, Ravi Sethi& Jeffrey D. Ullman, "Compilers Principles, Techniques & Tools", Pearson,1998.

References Books:

1. Allen, "Modern Compiler Implementation in C", Cambridge University Press, 1997
2. Alan Holub, "Compiler Design in C", PHI, 2004.
3. Vinu V. Das, "Compiler Design using FLEX and YACC", PHI, 2005

Paper ID: 44711 **L T/P C**

Code: IT711 **Paper: BlockChainTechnology** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Ability of students to understand the concepts of BlockChain Technology
CO 2	Ability of students to analyse basics of Cryptography and Digital Signatures
CO 3	Ability of students to understand the concepts of Ethereum Virtual Machine and Hyperledger
CO 4	Ability of students to understand concept of Public vs. Private Blockchains

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	2	2	2	2	1
CO 2	3	3	3	2	3	2	3	1	-	-	1	1
CO 3	3	3	2	2	2	3	3	2	2	1	-	-
CO 4	3	3	2	3	2	3	2	1	1	-	-	1

UNIT 1

Definition of BlockChain. Blocks Subdirectory. Data Storage in the Blockchain. Participants of the Blockchain. Description of Bitcoin Blockchain. Advantages and Disadvantages of using Blockchains. Introduction to MHRD's Virtual Lab.

UNIT 2

Physical and Digital Money. Defining E-Money : A Brief History of Money—Dispelling the Myths. Modalities of Interbank Payments. E-Money Wallets. Cryptography; Encryption and Decryption; Hashes; Digital Signatures; Digital Tokens. Tracking of Physical Objects; Notable Cryptocurrencies and Tokens. BLAST Algorithm.

UNIT 3

From Bitcoin to Ethereum; Enter the EthereumBlockchain; Ethereum Smart Contracts. Ethereum Virtual Machine and Code Execution; Ethereum Ecosystem. Ownership Structure in other Blockchains and Application. Hyperledger, Enterprise Ethereum, Quorum, Corda: Examples of Enterprise Blockchain Platforms

UNIT 4

Blockchain Application Development; Blockchain Application Development using REMIX/SOLIDITY; Interacting with the Bitcoin Blockchain; Interacting Programmatically with Ethereum—Sending Transactions; Interacting Programmatically with Ethereum—Creating a Smart Contract; Public vs. Private Blockchains; Decentralized Application Architecture

Text Books:

1. Lewis, Antony, "The basics of bitcoins and blockchains: an introduction to cryptocurrencies and the technology that powers them", Mango Media Inc., 2018.
2. Mahankali, Srinivas., "Blockchain: The Untold Story: From birth of Internet to future of Blockchain", BPB Publications, 2019.

References Books:

1. Singhal, Bikramaditya, GautamDhameja, and PriyansuSekhar Panda, "Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions", Apress, 2018.
2. Wattenhofer, Roger, "The science of the blockchain", CreateSpace Independent Publishing Platform, 2016.

Paper ID: 44713 **L T/P C**

Code: IT713 **Paper: E-Commerce** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	Ability of students to understand the history of E Commerce and different E Commerce Strategy.
CO 2	Ability of students to understand to understand the concepts of Ecommerce Models and Network Infrastructure
CO 3	Ability of students to understand to Understand the concepts of Electronic Payment Systems
CO 4	Ability of students to understand to Understand the concepts of E Security and Digital Signatures

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO 1	3	3	3	3	3	2	3	2	2	2	2	1
CO 2	3	3	3	2	3	2	3	1	-	-	1	-
CO 3	3	3	3	3	3	2	3	3	2	1	1	-
CO 4	3	3	2	2	2	3	2	1	1	-	1	1

UNIT 1:

Introduction to E-Commerce: The History of E-Commerce, E-Commerce Today, Consumer Behavior and E-Commerce , E-Commerce in Big and Small Businesses; Planning E-Commerce Strategy: Why Create an E-Commerce Strategy?, Creating Your E-Commerce Strategy, SWOT Analysis, Goal Setting, Budget, Inventory ,Timeline/Project Schedule. Framework, Architecture, Benefits and Impact of e-Commerce, The Anatomy of e-Commerce applications, e- CommerceConsumerapplications,e-CommerceOrganisationApplications,e-commerceinIndia,Prospectsofe- commerce.

UNIT 2

E-commerce Models: Business-to-Business-Hubs, Market Places, Business-to-Business Exchange, Business-to-Consumer, Consumer- to-consumer, Business-to-Government, Government-to-Government. e-Advertising & Marketing. Network Infrastructure for e-commerce : Intranet, Extranet, & Internet, Internet Backbone in India, ISP and services in India, OSI Model, Standards & Overview of TCP/IP, Internet Security, e-commerce & Internet.

UNIT 3

Electronic Payment Systems: Introduction to Payment Systems, On-Line Payment Systems, Pre-Paid e-Payment System, Post-Paid e-Payment System, Requirements Metrics of a Payment System, Electronic Data Exchange, EDI-Definitions & Applications. Role of National Payment Corporation of India. Standardization and EDI, EDI- Legal Security and Privacy Issues, Advantages & Limitations of EDI.

UNIT 4

E-Security: Securing the Business on Internet- Security Policy, Procedures and Practices, Transaction Security, Cryptology, Digital Signatures, Security Protocols for Web Commerce.; e-CRM : CRM, what is e-CRM, it's Applications.

Text Books:

1. Jeffrey F.Rayport& Bernard J.Jaworski, "Introduction to E-commerce", TMH, 2003.
2. Sims, Lisa," Building Your Online Store With WordPress and WooCommerce: Learn to Leverage the Critical Role E-commerce Plays in Today's Competitive Marketplace",Apress, 2018.

References Books:

1. Kalakota& Winston, "Frontiers of E-commerce", Pearson Education, Mumbai, 2002.
2. David Whiteley, "E-Commerce- Strategy technologies and Applications", Tata Mac GrawHill, New Delhi, 2000.

Paper ID: 44715 **L T/P C**
Code: IT715 **Paper: Cloud Computing** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: 75
Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	Ability of students to understand the concepts of SAAS, PAAS, IAAS
CO 2	Ability of students to analyze basics of SOAP,REST and Multi-Tenancy Approach
CO 3	Ability of students to understand the concepts of MICEF Computing
CO 4	Ability of students to understand concept of Privacy and Security in cloud.

Course Outcomes -Program Outcomes Matrix
Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	3	3	3	3	3	2	2	3	2	1
CO 2	3	2	3	3	3	2	3	2	3	2	2	1
CO 3	3	3	3	2	2	3	3	2	3	3	2	1
CO 4	3	3	3	2	3	3	3	2	3	4	2	1

UNIT 1

Introduction to Cloud Computing, Definition, Characteristics, Components, Cloud provider, SAAS, PAAS,IAAS and Others, Organizational scenarios of clouds, Administering &Monitoring cloud services, benefits and limitations, Comparison among SAAS, PAAS, IAAS, Cloud computing platforms: Infrastructure as service: Amazon EC2,Platform as Service: Google App Engine, Microsoft Azure.

UNIT 2

IntroductiontoCloudTechnologies,StudyofHypervisors,SOAP,REST,Comparison ofSOAPand REST, Webservices, mashups-Web services, Mashups: user interface services, Virtualmachinetechnology,virtualizationapplicationsinenterprises,Pitfallsofvirtualization, Multi-entity support, Multi-schema approach, Multi-tenance using cloud data stores.

UNIT 3

Datainthecloud:Relationaldatabases,Cloudfilesystems:GFSandHDFS,BigTable,HBaseand Dynamo, Map-Reduce and extensions: Parallel computing, The map-Reduce model. MICEF Computing(Mist, IOT, Cloud, Edge and FOG Computing): Concept and Application

UNIT 4

Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud, Cloudcomputing security architecture, Issues in cloudcomputing,IssuesinIntercloud environments,QoSIssuesinCloud, StreaminginCloud.Quality of Service (QoS) monitoring in a Cloud computing environment, Inter Cloud issues, load balancing, resourceoptimization.

Text Books:

1. Sosinsky Barrie "Cloud Computing Bible", Wiley India, 2011
2. Buyya, Rajkumar, James Broberg, and Andrzej M. Goscinski, eds.," Cloud computing: Principles and paradigms". Vol. 87. John Wiley & Sons, 2010.
3. Jayaswal, Kailash. "Cloud Computing Black Book". John Wiley & Sons, 2014.

References Books:

1. Velte, Anthony T., Toby J. Velte, and Robert Elsenpeter. "Cloud Computing: A Practical Approach." McGraw-Hill, Inc. 2019
2. Gerardus Blokdyk , "Cloud Computing : A Complete Guide",5 Starcooks, 2019.

Paper ID: 44717 **L T/P C**

Code: IT717 **Paper: Semantic Web Technologies** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Ability of students to understand the basic concepts of web, its technologies and development.
CO 2	Ability of students to understand the Semantic Web fundamental concepts, issues, architecture and technologies.
CO 3	Ability of students to understand the various technologies of Semantic Web focusing on RDF, Ontology and Sparql.
CO 4	Ability of students to understand the latest trends and applications of Semantic Web.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	2	2	2	3	2	1	-	-	-	1
CO 2	3	3	2	2	2	2	2	1	2	-	-	1
CO 3	3	3	3	1	3	2	3	2	1	-	-	-
CO 4	3	3	3	1	3	2	3	2	1	-	-	-

UNIT 1

Review of Internet and Web: History, Internet protocols and services, OSI Seven layer model, terms and terminologies, concepts like WWW, W3C, ISP, DNS, Search Engines etc. HTML and it'stags, various web development issues and technologies.Web 1.0 and Web 2.0.

UNIT 2

Semantic Web:Limitations of Web 2.0, Need of Web 3.0, Sir Tim Berners LEE vision and contributions, Semantic Web vision and roadmap, Semantic web fundamental concepts and issues,Semantic Web architecture layered cake and technologies, XML basics and metadata, Jorge Cardoso Survey, scientific American article 2001.

UNIT 3

RDF, Ontology and SPARQL: Overview of various technologies of Semantic Web with focus on pillar technologies.Semantic Web standards, RDF basics and examples,RDFS, Ontology and its issues, OWL, Ontology design and development, using Ontology editor Protégé, benefits and challenges of Ontologies, SPARQL and its concerns, Exporting SPARQL query using tools like Protégé, Twinkle etc

UNIT 4

Applications and upcoming trends: An overview of various Semantic Web Services and applications, Semantic Annotation, Information Extraction and Retrieval, Semantic Search, Semantic Agents and Search Engines, Semantic Social Networks, Web Intelligence, SWoT, Chatbots, Web Data Analytics. An overview: Machine Learning, Deep Learning, Blockchain and other upcoming concerns of Semantic Web.

Text Books:

1. RajendraAkerkar, "Foundations of the Semantic Web:XML,RDF and Ontology" ,Oxford, 2009.
2. Karin Breitman and Marco, "Semantic Web: Concepts, Technologies and Applications", Springer. 2009,
3. Berners-LEE, Godel and Turing, "Thinking on the Web", Wiley, 2006.

References Books:

1. John Hebeler, Mathew Fisher and Ryan Blace, "Semantic Web Programming", Wiley, 2011
2. Krotzsch and Rudolph, "Foundations of Semantic Web Technologies", SRC Press, 2009.
3. Grigoris Antoniou and Paul Groth, "A Semantic Web Primer", MIT Press, 2012.

Paper ID: 44719 **L T/P C**
Code: IT719 **Paper: Natural Language Processing** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

1	Ability of students to understand the algorithmic approach to NLP
2	Ability of students to understand the sentence structure and the Computational model of Natural Languages
3	Ability of students to understand the Data Science approach to Machine Translation and its applications
4	Ability of students to understand Machine Learning approach to NLP

Course Outcomes -Program Outcomes Matrix
Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	2	2	2	2	2	2	2	2	2	2
CO 2	3	3	3	2	3	3	2	3	2	2	2	2
CO 3	3	3	3	2	3	3	2	3	2	2	2	2
CO 4	3	3	3	2	3	3	2	3	3	2	2	2

UNIT 1

Introduction to NLP: Characteristics of Natural Language, Language structure, Sentence Structure, Language analyzer, Lexicon, word formation, Morphology, syntax analysis (parsing), semantics, ambiguity, pragmatics and discourse

UNIT 2

NLP Algorithms: Understanding Corpus and data attributes, Corpus Formats CSV, JSON, XML, LibSVM, Operations on Text Corpus, Tokenisation, stop words, Term Frequency Inverse Document Frequency (TF-IDF), Text Analysis and word embedding using word2vec, doc2vec, GLoVe, Bag-of-words (BoW).

UNIT 3

Machine Translation and Applications of NLP:Introduction to Machine Translation (MT), Approaches, Structure of Anusaraka: an Interlingua based MT system, Example/Analogy based MT, Word/phrase based MT, Neural MT. Applications of NLP: Sentiment analysis, chatbots, conversational models (Question Answering system) for Digital Assistants

UNIT 4

Deep learning models for NLP: Neural Net based NLP models: Study of Convolutional Neural Network(CNN), Recurrent Neural Network(RNN), Long Short-Term Memory (LSTM) and Gated Recurrent Unit(GRU) using Natural Language Toolkit (NLTK)

Text Books:

1. Chaitanya, Vineet, Rajeev Sangal, and AksharBharati. "Natural language processing: aPaninian perspective". Prentice-Hall of India, 1996.
2. Thanaki, Jalaj. "Python natural language processing". Packet Publishing Ltd, 2017.

References Books:

1. Syal, Pushpinder, and DharamVir Jindal. "An introduction to linguistics: Language, grammar and semantics" PHI Learning Pvt. Ltd., 2007.

2. Samuel Burns “Natural Language Processing: A Quick Introduction to NLP with Python and NLTK” Independently Published, 2019
3. Bird, Steven, Ewan Klein, and Edward Loper. “Natural language processing with Python: analyzing text with the natural language toolkit." O'Reilly Media, Inc.", 2009.
4. NPTEL course on “Applied Natural Language Processing”, R. Ramachandran. URL: https://nptel.ac.in/courses/106106211/

Paper ID: 44721 **L T/P C**

Code: IT721Paper: Advanced Database Management Systems **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	To be able to understand the advanced concepts of relational database systems
CO 2	To be able to have in-depth knowledge of query processing and transaction processing.
CO 3	To have knowledge of other types of databases like Parallel, Distributed and object oriented
CO 4	To have basic knowledge of data warehousing and data mining.

Course Outcomes - Program

Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	-	2	-	1	-	-	-	1	-
CO 2	3	3	3	-	2	-	1	-	-	-	1	-
CO 3	3	3	3	-	2	-	1	-	-	-	1	-
CO 4	3	3	3	-	2	-	1	-	-	-	1	-

UNIT 1

Integrity Constraints revisited, Extended ER diagram, Relational Algebra & Calculus, Functional, Muiltivalued and Join Dependency, Normal Forms, Rules about functional dependencies.

UNIT 2

Query Processing and Optimization: Valuation of Relational Operations, Transformation of Relational Expressions, Indexing and Query Optimization, Limitations of Relational Data Model, Null Values and Partial Information.Advanced Transaction Processing: Nested and Multilevel Transactions, Compensating Transactions and Saga, Long Duration Transactions, Weak Levels of Consistency, Transaction Work Flows, Transaction Processing Monitors.

UNIT 3

Parallel and Distributed Databases: Distributed Data Storage – Fragmentation & Replication, Location and Fragment Transparency Distributed Query Processing and Optimization, Distributed Transaction Modeling and concurrency Control, Distributed Deadlock, Commit Protocols, Design of Parallel Databases, Parallel Query Evaluation. Objected Oriented and Object Relational Databases: Modeling Complex Data Semantics, Specialization, Generalization, Aggregation and Association, Objects, Object Identity, Equality and Object Reference, Architecture of Object Oriented and Object Relational Databases

UNIT 4

Data Mining: Knowledge Representation Using Rules, Association and Classification Rules, Sequential Patterns, Algorithms for Rule Discovery. Data Warehousing: Data Warehousing Architecture, Multidimensional Data Model, Update Propagation. Case Studies for Data mining and Data warehousing.

Text Books:

1. R. Elmsari and S. B. Navathe, "Fundamentals of database systems", 7th Edition, Pearson Education, 2018
2. A. Silberschatz, H. F. Korth and S. Sudershan, "Database System Concept", 6th Edition , McGraw Hill, 2013.

References Books:

1. Date, C. J., "An introduction to database systems", 8th Edition, Pearson Education, 2008.
2. P. Rob & C. Coronel, "Database Systems: Design Implementation & Management", Thomson Learning, 6th Edition, 2004
3. Desai, B., "An introduction to database concepts", Galgotia publications, 2010

Paper ID: 44723 **L T/P C**
Code: IT723 **Paper: Social Network Analysis** **4 04**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	Ability to identify and describe the type of complex network
CO 2	Ability to visualise a social network to mine meaningful pattern.
CO 3	Ability to detect evolving communities in a network
CO 4	Ability to predict potential connections (colloberations) in a dynamic network

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	-	-	-	-
CO 2	3	3	2	3	3	-	-	-	-	-	-	-
CO 3	3	3	2	3	2	-	-	-	-	-	-	-
CO 4	3	3	1	3	2	-	-	-	-	-	-	-

UNIT 1

Graph Preliminaries and Networks: Overview of graphs and types of graphs including Bipartite and Planar networks, Introduction to Social Networks, Types of Networks: General Random Networks, Small World Networks, Scale-Free Networks; Examples of Information Networks

UNIT 2

Centrality Measures: Network Centrality Measures; Strong and Weak ties; Homophily, Random walk-based proximity measures, Other graph-based proximity measures. Clustering with random-walk based measures. Applications based on the analysis of centrality measures.

UNIT 3

Community Detection] Algorithms for Community Detection: The Kernighan-Lin algorithm, Agglomerative/Divisive algorithms, Multi-level Graph partitioning, Markov Clustering; Community Discovery in Directed Networks, Dynamic Networks, and Heterogeneous Networks., Applications of Community detection.

UNIT 4

Link Prediction: Feature based Link Prediction, Bayesian Probabilistic Models, Probabilistic Relational Models, Linear Algebraic Methods: Network Evolution based Probabilistic Model, Hierarchical Probabilistic Model, Relational Bayesian Network. Relational Markov Network, Applications of Link Prediction.

Text Books:

1. M.E.J. Newman, "Networks : An Introduction", Oxford University Press, 2012

References Books:

1. John Scott, "Social Network Analysis", Sage Publication, 2012
2. Filippo Menczer, "A First Course in Network Science", Cambridge University Press, 2014

Paper ID: 44725 **L T/P C**
Code: IT725 **Paper: Scientific Computing in Python** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	To introduce to the basic techniques of python.
CO 2	To provide knowledge of floating point representation, calculus
CO 3	To develop some understanding of linear and non linear equations
CO 4	To introduce interpolation, differential equations

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	1	3	-	2	2	-	-	2	2
CO 2	3	3	3	1	3	-	2	2	-	-	2	2
CO 3	3	3	3	1	3	-	2	2	-	-	2	2
CO 4	3	3	3	1	3	-	2	2	-	-	2	2

UNIT 1

Python: Python shell; variables, objects and expressions; numerical python arrays; built in data types and functions; loops and branching constructs; functions (including lambda functions); lists, sets, tuples, dictionaries and files; Classes and objects, encapsulation and inheritance. NumPy array, indexing and slicing, reshaping and resizing, Code vectorization. NumPy methods, SciPy and its methods, Matplotlib and its methods.

UNIT 2

Number representation and errors: Floating point number representation in python; Sources of errors: Rounding, Truncation, Ill-conditioning; Measures of errors and precision, floating point arithmetic.

Numerical Calculus: Numerical differentiation, Numerical Integration: Mid-point rule, Trapezoid rule, Simpson's 1/3 rule, Gaussian quadrature, Romberg's integration formula.

UNIT 3

Linear equations: Gauss elimination method, pivoting, Tridiagonal systems; LU factorization; Iterative algorithms: Jacobi method, Gauss – Seidel method; Least square estimation; Eigenvalue: Power method, inverse iteration. Non-linear equations: Root finding: Bisection method, fixed point iteration, Newton's method, Secant method.

UNIT 4

Interpolation: Lagrange interpolation; divided difference interpolation, splines. Differential equations: Euler's method, Runge-Kutta method (2^{nd} order) with idea of 4^{th} order, Adams–Bashforth method; Systems of differential equations.

Text Books:

1. S. Linge, H. P. Langtangen, "Programming for computations – Python", Springer Open, 2^{nd} Ed., 2020.
2. P. R. Turner, T. Arildsen, K. Kavanagh, "Applied Scientific Computing with Python", Springer Nature, 2018.

References Books:

1. S. Gowrishankar, A. Veena, "Introduction to Python Programming", CRC Press, 2019.
2. M. T. Heath, "Scientific Computing: An Introductory Survey", 2^{nd} Ed., SIAM, 2018.
3. R. Johansson, "Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib", 2^{nd} Ed., Apress, 2019.
4. John V. Guttag, "Introduction to Computation and Programming using Python", PHI, 2016.
5. Martin C. Brown, "The Complete Reference Python ", 4^{th} Edition, McGraw Hill, 2018

Paper ID: 44727 **L T/P C**
Code: IT727 **Paper: Agile Methodology and Devops** **4 04**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability & Skill Development

Course Outcomes:

CO 1	To Understand Agile Methodologies, Life cycle management and Scrum Framework
CO 2	To be able to use agile management tools like JIRA and Git
CO 3	To be able to understand the need of Devops on Agile Projects
CO 4	To understand delivery pipeline, configuration management, Containerization and Deployment

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	2	3	-	3	3	3	-	3	1
CO 2	3	3	3	2	3	-	3	3	3	-	3	1
CO 3	3	3	3	2	3	-	3	3	3	-	3	1
CO 4	3	3	3	2	3	-	3	3	3	-	3	1

UNIT 1

Introduction to Agile: Agile versus traditional method comparisons and process tailoring. Software Process Models – overview, Introduction to Agile, Various Agile methodologies -Scrum, XP, Lean, and Kanban, Agile Manifesto, Agile Principles. Scrum Fundamentals: Scrum framework, Scrum Roles, Scrum Events, Scrum Artifacts, Sprint velocity, team management, conflict management. Scrum Planning and Change management: User story estimation techniques, User story prioritization techniques, User story splitting techniques, Team exercise (hands on) to form a product backlog and its grooming using above techniques, change management

UNIT 2

Agile Lifecycle Management (ALM) tools: Definition of done, Definition of ready, predicting velocity, burn down and burn up charts, measure with metrics, ALM and team communication tools: Trello, Rally, JIRA, slack boat, Asana Refer Blogs, Tools websites

Extreme Programming (XP): Extreme Programming Values, Principles and Practices, Pair programming, mob programming, behavioral driven development (BDD) code refactoring, refactoring examples.

UNIT 3

DevOps: Need for Devops on agile projects, DevOps Stages, Continuous Integration (CI), Continuous Delivery (CD) and Continuous Deployment (CDep), Continuous monitoring, DevOps Tool support.

Git and GitHub: Git: Creating and merging different git branches, git structure, git pull, git push, committing the code and updating the code in git. GitHub: Pushing and pulling the code to remote repository, creating pull requests.

UNIT 4

Delivery Pipeline and configuration management – Jenkins: Introduction to delivery pipeline, adding slave nodes to Jenkins, adding Testing, adding selenium webdriver, creating continuous delivery pipeline, writing groovy scripts to automate delivery pipeline, installing chef and creating chef cookbooks, ansible basics, ansible on cloud.

Containerization and Deployment: Introduction to containerization, container life cycle, starting docker container, introduction to Kubernetes, creating kubernetes clusters, creating service in kubernetes, deploying an application using dashboard, continuous monitoring using Nagios.

Text Books:

1. Kenneth S Rubin, "Essential Scrum: A practical guide to most popular agile processes", Second Edition, Addison-Wesley Professional, 2012.

2. Cohn, Mike, " Agile estimating and planning. Prentice Hall", 1st edition, 2006.
3. SricharanVadapalli , "DevOps: Continuous Delivery, Integration, and Deployment with DevOps: Dive", Packt, 2018.

References Books:

1. Lisa Crispin, Janet Gregory , "Agile Testing: A Practical Guide For Testers And Agile Teams", Pears--on, 2010
2. Thomas Uphill, John Arundel ,NeependraKhare, Hideto Saito, Hui-Chuan Chloe Lee, Ke-Jou Carol Hsu, "DevOps: Puppet, Docker, and Kubernetes", Packt, 2017

Paper ID: 44729 **L T/P C**

Code: IT729 **Paper: Object Oriented Analysis and Design** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Ability of students to understand object oriented concepts and methodologies.
CO 2	Ability of students to understand modelling through the use of UML.
CO 3	Ability of students to implement the object oriented analysis through UML
CO 4	Ability of students to implement the object oriented design through UML

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	2	1	3	-	2	2	2	2	2	2
CO 2	3	3	2	1	3	-	2	3	2	2	2	2
CO 3	3	3	3	3	3	-	2	3	2	2	2	2
CO 4	3	3	3	3	3	-	3	3	3	2	2	2

UNIT 1

Role of Analysis and Design in Software Development , Review of structured analysis and design techniques, Drawbacks of structured paradigm, Review of object Orientation concepts, drawbacks of object oriented paradigm ,What is Object-Oriented Analysis and Design (OOAD), Overview of Various OOAD Methodologies like Booch Methodology , Coad and Yourdon Methodology and others, Goals of UML.

UNIT 2

Unified Modeling Languages (UML): An Overview of the UML, A Conceptual Model of the UML, Basic Structural Modeling: Classes, interfaces, packages, class diagram, object diagrams. Behavioural modelling: Interactions, Interaction Diagrams, Activity Diagrams, statechart diagram, Components, Deployment, Component Diagrams, Deployment Diagrams

UNIT 3

Object oriented Analysis: Developing the System Idea and Objective, Identifying Stakeholders, Identifying Business, Identifying Stakeholders' Interests, Identifying Business Use Cases, Describing the Essence of Use Cases, Identifying System Use Cases, Describing the Requirements, Identifying Business Classes, Developing a Use Case Process Model,Describing the System Interface , Analysis Patterns.

UNIT 4

Object oriented Design: Defining the Application Architecture, Identifying Domain Components, Developing Component-specific Class Models, Developing State Models, Identifying and, Restructuring Component Dependencies, Designing Component Interfaces, Developing Collaboration Models, Developing Process-oriented Component Tests, Developing Class Tests, Defining Attributes. Design Patterns

Text Books:

1. Bernd Oestereich, Bernd Cestereich, "Developing Software with UML(The Addison-Wesley Object Technology Series)", Addison Wesley, July 2002
2. Booch G., Rambaugh J., Jacobson Ivar, "The Unified Modeling Language User Guide", Pearson Ed--ucation, 2003

References Books:

1. SarnathRamnath and Brahma Dathan," Object-Oriented Analysis and Design", Springer-Verlag London, 2015
2. PeretzShoval , "Functional and Object Oriented Analysis and Design: An Integrated Methodology",

Idea Group Publishing, 2001

3. Craig Larman, "Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development", 2nd edition, Prentice Hall
4. Booch G, Maksimchuk, Engel, Young, Conallen and Housten, "Object Oriented Analysis and Design with Applications", Addison Wesley Professional, 2007
5. Ali Bahrami, "Object Oriented Systems Development", Tata McGraw Hill, 2017.
6. Mahesh P. Matha, "Object-Oriented Analysis and Design Using UML: An Introduction to Unified Process and Design Patterns", PHI Learning Pvt. Ltd, 2008

Paper ID: 44731 **L T/P C**

Code: IT731 **Paper: Network Security** **4 04**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Ability of students to understand the concepts of Cryptographic Techniques
CO 2	Ability of students to understand the concepts of Symmetric and Asymmetric Cryptography Algorithms
CO 3	Ability of students to understand Hashing and Digital Signatures
CO 4	Ability of students to understand concept of Kerberos and Attacks.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO 1	3	3	3	3	3	3	3	3	2	2	2	1
CO 2	3	3	3	2	2	2	3	2	1	1	1	1
CO 3	3	3	2	2	2	3	3	3	2	1	1	1
CO 4	3	3	2	3	2	2	3	2	1	1	1	1

UNIT 1

Essence of Cryptography, Mathematics of Cryptography, Symmetric and Asymmetric Cryptography, Classical Encryption techniques: Monoalphabetic and Polyalphabetic Cipher Technique: Caesar Cipher, Autokey Cipher, Vigenere Cipher, Rail Fence Cipher, Affine Cipher.

Social Cryptographic Techniques: Triplicative, Quadraplicative and Pentaplicative Cipher Technique. Cross Language Cipher Technique, Bi-Lingual Cross Language Cipher Technique

UNIT 2

Key Management – Diffie - Hellman key Exchange Algorithm.Symmetric and Asymmetric Cryptography Algorithms : Data Encryption Standard(DES), Advanced Encryption Standard (AES) and RSA Algorithm. Introduction to Elliptic Curve Architecture and Quantum Computing

UNIT 3

Authentication functions – Message Authentication Codes, Hash Functions, Message Digest algorithm (MD 5), Digital Signatures, BlockChain Technology, BLAST Algorithm: BlockChain Algorithm for Secure Transactions.

UNIT 4

Authentication Applications: Kerberos – X.509, PGP, S/MIME – Penetration Testing. Web Security. Java Cryptography Architecture(JCA) and JSSE(Java Secure Socket Extension Programming).Intrusion detection System – Threats and Attacks: Active and Passive Attacks.

Text Books:

1. William Stalling "Cryptography and Network Security : Principles and Practice" 7th Ed., Pearson, 2017.
2. Behrouz A. Forouzan "Cryptography and Network Security" 3rdEd.,TMH, 2015.

References Books:

1. Charlie Kaufman ,Radia Perlman et al , "Network Security: Private Communication in a Public World", 2nd Ed., Pearson,2015.
2. AtulKahate "Cryptography and Network Security" 4thEd.,TMH, 2019.

Paper ID: 44733 **L T/P C**

Code: IT733 **Paper: Cyber Security** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Ability of students to understand the risk and issues of cyber-crime.
CO 2	Ability of students to understand the cyber-crime types
CO 3	Ability of students to explore about tools to be used in Cyber Forensics.
CO 4	Ability of students to explore fundamentals of cryptography, Incident Response and evidence seizing process.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO 1	3	3	3	3	3	3	3	3	2	2	2	1
CO 2	3	3	3	2	3	2	3	2	1	2	1	1
CO 3	3	3	2	2	2	3	3	3	2	1	1	1
CO 4	3	3	2	3	2	1	3	2	1	1	1	1

UNIT 1

Introduction:Types of cyber-attacks, Cyber Crime and Digital Fraud, Cyber-attacks and cyber security

Overview of Types of computer forensics i.e. Media Forensics, Network forensics (internet forensics), Machine forensic, Email forensic (e-mail tracing and investigations)

UNIT 2

Under Standing Computer Investigations : Preparing a Computer Investigations, Taking a systematic approach, Understanding Data recovery workstations and software, Conducting an Investigation, Completing the case, Processing Crime and Incident Response: Identifying Digital evidences, Collecting evidence, Preparing for a search, Seizing and Storing Digital evidences, Digital Hashing.

UNIT 3

Windows and DOS systems based Investigations: Windows registry, startup tasks, Linux Boot processes and File systems, Digital signature and time stamping, cryptography, cell phone and mobile device forensics, Email investigations, Network Forensics, SQL Injections, Steganography.

UNIT 4

Computer Forensics Tools and Software: Helix, DTsearch, S-tools, Camouflage, Recovery of Deleted files in windows and Unix , Hardware forensic tools like Port scanning and vulnerability assessment tools like Nmap , Netscanetc . Password recovery e.g. Passware, Mobile forensic tools , DOS file systems and Forensic tools, Password encryption analyzer

Text Books:

1. Nelson, Phillips, Enfinger,Steuart, "Computer Forensics and Investigations", 2nd edition, Cengage Learning, 2008
2. Mandia, k., Prosise, C., Pepe, M.," Incident Response & Computer Forensics", 2nd edition. Tata-McGraw Hill, 2003.

References Books:

1. Harlan Carvey, " Windows Forensic Analysis DVD Toolkit", 2nd editionSyngress Publication
2. Steve Bunting, "EnCE: The Official EnCase Certified Examiner Study Guide", 2nd Edition, Sybex Publication

Paper ID: 44735 **L T/P C**

Code: IT735 **Paper: Soft Computing** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	To provide an introduction to the basic principles, techniques, and applications of soft computing.
CO 2	To provide the mathematical background for carrying out the optimization associated with neural network learning.
CO 3	To have an understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Systems and Genetic Algorithms.
CO 4	To develop some understanding of various application areas of Soft Computing

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	3	3	-	2	1	3
CO 2	3	3	3	3	3	2	3	3	-	2	1	3
CO 3	3	3	3	3	3	2	3	3	-	2	1	3
CO 4	3	3	3	3	3	2	3	3	-	2	1	3

UNIT 1

Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, Neural Computing, Fuzzy Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, Various applications of Soft Computing.

UNIT 2

Model of Artificial Neuron, Architectures, Learning Methods, Deep learning, Taxonomy of ANN Systems, Single-Layer ANN System, Supervised Learning Neural Networks, Perceptron, Adaline, Back propagation, Multilayer Perceptron, Applications of ANN.

UNIT 3

Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, introduction & features of membership functions, Extension Principle, Fuzzy If-Then Rules, Fuzzy Inference Systems, Sugeno Fuzzy Models, Fuzzification, De-fuzzification, Applications of Fuzzy Systems.

UNIT 4

Fundamentals of Genetic Algorithms, basic concepts & working principle, encoding, fitness function, reproduction, Genetic modelling, Applications of GA, Hybrid Systems: Integration of Neuro, Fuzzy and Genetic Systems.

Text Books:

1. S. Rajasekaran, G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
2. S.N.Sivanandam, S.N.Deepa, "Principles of Soft Computing ", Wiley India, 2007

References Books:

1. Simon O. Haykin "Artificial Neural Network", PHI, 2003
2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

Paper ID: 44737 **L T/P C**

Code: IT737 **Paper: Big Data and Nosql** **4 04**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	To be able to understand the Big Data Platform.
CO 2	To have basic knowledge of mining data streams.
CO 3	To have a knowledge of Hadoop and MapReduce.
CO 4	To be able to interface and interact with NoSQL.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	-	2	-	1	-	-	-	1	-
CO 2	3	3	3	-	2	-	1	-	-	-	1	-
CO 3	3	3	3	-	2	-	1	-	-	-	1	-
CO 4	3	3	3	-	2	-	1	-	-	-	1	-

UNIT 1

Introduction to big data: Introduction to Big Data Platform, Challenges of Conventional Systems. Intelligent data analysis, Nature of Data, Analytic Processes and Tools. Analysis vs Reporting. Modern Data Analytic Tools. Statistical Concepts: Sampling Distributions, Re-Sampling, Statistical Inference, Prediction Error

UNIT 2

Mining data streams: Introduction To Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform(RTAP) Applications. Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT 3

HADOOP: History of Hadoop,The Hadoop Distributed File System,Components of Hadoop,Analyzing the Data with Hadoop, Scaling OutHadoop Streaming,Design of HDFS,Java interfaces to HDFS, BasicsDeveloping a Map Reduce Application,How Map Reduce Works,Anatomy of a Map Reduce Job run-Failures-Job Scheduling,Shuffle and Sort, Task execution, Map Reduce Types and Formats,Map Reduce Features.

UNIT 4

NOSQL: Definition & Introduction, Sorted Ordered Column-Oriented Stores,Key/Value Stores, Document Databases, Graph Databases, Interfacing and Interacting with NOSQL, Storing and Accessing Data, Storing Data In and Accessing Data from MongoDB, Querying MongoDB, Storing Data In and Accessing Data from Redis,Querying Redis, Storing Data In and Accessing Data from HBase, Querying HBase.Understanding storage architecture, Working with column oriented databases, HBase Distributed Storage Architecture, Document Store Internals, Understanding Key/Value Stores in Memcached and Redis, Eventually Consistent Non-relational Databases, Similarities Between SQL and MongoDB Query Features.

Text Books:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Tom White " Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012
4. ShashankTiwary, "Professional NOSQL", John Wiley & Sons, 2011.

References Books:

1. AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University

Press, 2012.
2. Paul Zikopoulos ,DirkdeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Cor rigan, "Harness the Power of Big Data The IBM Big Data Platform", Tata McGraw Hill Publications, 2012
3. Joe Celko, "Complete Guide To NoSQL- What Every SQL Professional Needs To Know About Non-Relational Databases", Morgan Kauffman, 2014.
4. Kristina Chodorow, Michael Dirolf, "MongoDB-The Definitive Guide" O'reilly 2010.

Paper ID: 44739 **L T/P C**

Code: IT739 **Paper: Nature Inspired Algorithms** **4 04**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability & Skill Development

Course Outcomes:

CO 1	To appreciate the use of biological processes in building intelligent systems
CO 2	To understand the use of Evolutionary and geneticalgorithms in addressing computationally interactable problems.
CO 3	Ability to solve real word optimisation problems using bio-inspired algorithm
CO 4	To understand the underlying mathematics of collective intelligence based systems.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	3	1	-	-	-	-	-	-	-
CO 2	3	3	3	2	1	-	-	-	-	-	-	-
CO 3	3	2	3	2	2	-	-	-	-	-	-	-
CO 4	3	3	2	3	1	-	-	-	-	-	-	-

UNIT 1

Optimization and Meta-heuristics What is optimization?, Newton ' s method, optimization algorithm - No-Free-Lunch Theorems, Analysis of Algorithms and computational interactibility, Nature-Inspired algorithms framework, Parameter tuning and parameter control.

UNIT 2

Random Walk and Simulated Annealing Random walks, Markov chains, step sizes and search efficiency, Modality and intermittent search strategy, importance of randomization, Eagle strategy, Annealing and Boltzmann Distribution, Simulated annealing.

UNIT 3

Genetic algorithms and Differential Evolution Genetic Algorithm, Genetic Representations, Initial Population, Fitness Function, Selection and Reproduction, Genetic Operators(Selection, Crossover, Mutation), schema theorem, convergence analysis, introduction to differential evolution (DE), DE variants, choice of parameters, convergence analysis, Applications as case study.

UNIT 4

Collective Systems Collective Systems Collective Behavior and Swarm Intelligence, Particle Swarm Optimization and Ant Colony Optimization, Artificial evolution of Competing Systems, Artificial Evolution of cooperation and competition, Applications as case study.

Text Books:

1. Xin-She Yang, "Nature-Inspired Optimization Algorithms", 1st edition, Elsevier

References Books:

1. Sean Luke, "Essentials of Metaheuristics" A Set of Undergraduate Lecture Notes. Lulu, 2013
2. D. E. Goldberg, "Genetic algorithms in search, optimization, and machine learning", AddisonWesley,1989

Paper ID: 44741 **L** **T/P** **C**
Code: IT741 **Paper: Advanced Computer Architecture** **4** **0** **4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Ability of students to understand concept of parallel computing and hardware technologies.
CO 2	Ability of students to differentiate control flow, data flow, demand driven mechanisms.
CO 3	Ability of students to understand the principles of scalable performance, and advanced processor architectures.
CO 4	Ability of students to the basics of instruction pipelining and memory technologies.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	3	1	1	-	2	1	3	-	-	1
CO 2	2	2	2	1	2	-	2	1	2	-	-	-
CO 3	3	2	2	1	1	-	2	2	1	-	-	-
CO 4	2	2	2	1	1	-	2	1	2	-	-	1

UNIT 1

Parallel Computer Models: The state of computing, Classification of parallel computers, Multiprocessors and multicomputer, Multivectors and SIMD computers.

Program and Network Properties: Conditions of parallelism, Data and resource Dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms.

UNIT 2

Principles of Scalable Performance: Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches.

Processors and Memory Hierarchy: Advanced Processor Technology, Superscalar and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology.

UNIT 3

Pipelining and Superscalar Techniques**:** Linear Pipeline Processors, Nonlinear Pipeline Processors, Instruction Pipeline Design, Arithmetic Pipeline Design

Multiprocessors and Multicomputers: Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, Three Generations of Multicomputers, Message-Passing Mechanisms.

UNIT 4

Multivector and SIMD Computers: Vector Processing Principles, Multivector Multiprocessors, Compound Vector Processing, SIMD Computer Organizations.

Scalable, Multithreaded, and Dataflow Architectures: Latency-Hiding Techniques, Principles of Multithreading, Fine-Grain Multicomputers, Scalable and Multithreaded Architectures, Dataflow and Hybrid Architectures.

Text Books:

1. Kai Hwang and NareshJotwani, "Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability", McGraw Hill Education 3rd edition.

References Books:

1. John L. Hennessy and David A. Patterson, "Computer Architecture: A quantitative approach", 5th edition, Morgan Kaufmann Elsevier, 2013.
2. M.J. Flynn, Computer Architecture, "Pipelined and Parallel Processor Design", Narosa Publishing, 2007

Paper ID: 44743 **L T/P C**

Code : IT743 **Paper: Software Defined Networks** **4 0 4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability & Skill Development

Course Outcomes:

CO1	Explain the key benefits of SDN by the separation of data and control planes. Interpret the SDN data plane devices and Openflow Protocols
CO2	Implement the operation of SDN control plane with different controllers
CO3	Apply techniques that enable applications to control the underlying network using SDN
CO4	Describe Network Functions Virtualization components and their roles in SDN

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	3	1	1	-	2	1	3	-	-	1
CO 2	2	2	2	1	2	-	2	1	2	-	-	-
CO 3	3	2	2	1	1	-	2	2	1	-	-	-
CO 4	2	2	2	1	1	-	2	1	2	-	-	1

UNIT 1

SDN Background and Motivation: Evolving network requirements-The SDN Approach: Requirements, SDN Architecture, Characteristics of Software-Defined Networking, SDN and NFV-Related Standards: Standards-Developing Organizations, Industry Consortia, Open Development Initiatives.

UNIT 2

SDN Data plane and Control Plane. SDN data plane: Data plane Functions, Data plane protocols, Openflow logical network Device: Flow table Structure, Flow Table Pipeline, The Use of Multiple Tables, Group Table- OpenFlow Protocol. SDN Control Plane Architecture: Control Plane Functions, Southbound Interface, Northbound Interface, Routing, ITU-T Model- OpenDaylight-REST- Cooperation and Coordination Among Controllers.

UNIT 3

SDN Application Plane Architecture: Northbound Interface, Network Applications, User Interface- Network Services Abstraction Layer: Abstractions in SDN, Frenetic- Traffic Engineering Measurement and Monitoring-Security- Data Center Networking- Mobility and Wireless.

UNIT 4

Network Functions Virtualization: Background and Motivation for NFV- Virtual Machines- NFV Concepts: Simple Example of the Use of NFV, NFV Principles, High-Level NFV Framework, NFV Benefits and Requirements- NFV Reference Architecture: NFV Management and Orchestration.

Text Books:

1. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", First Edition, Morgan Kaufmann, 2014.
2. Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.

References Books:

1. SiamakAzodolmolky, "Software Defined Networking with Open Flow", Packet Publishing, 2013.
2. Vivek Tiwari, "SDN and Open Flow for Beginners‖", Amazon Digital Services, Inc., 2013.
3. Fei Hu, Editor, "Network Innovation through Open Flow and SDN: Principles and Design", CRC Press, 2014.

Paper ID: 44745 **L T/P C**

Code: IT745 **Paper: Digital Image Processing** **4 04**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Employability, Entrepreneurship & Skill Development

Course Outcomes:

CO 1	Ability of students to understand the basic fundamentals of digital images and color fundamentals
CO 2	Ability of students to learn various image enhancement techniques in spatial domain and frequency domain
CO 3	Ability of students to understand image restoration and reconstruction techniques
CO 4	Ability of students to learn image segmentation, representation and description.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	3	2	3	3	3	-	3	2	2	2
CO 2	3	2	3	2	3	3	3	-	3	2	2	2
CO 3	3	2	3	2	3	3	3	-	3	2	2	2
CO 4	3	2	3	2	3	3	3	-	3	2	2	2

UNIT 1

Digital image fundamentals- Elements of visual perception, Image sampling and quantization, basic relationship between pixels, Introduction to mathematical tools used in image processing, DFT, 2D-DFT and its properties Color fundamentals, basics of color image processing

UNIT 2

Image enhancement techniques- basic intensity transformation functions, histogram processing, Spatial domain filtering (smoothing and sharpening filters), frequency domain filtering (smoothing and sharpening filters)

UNIT 3

Image Reconstruction and restoration: Image degradation and restoration model, Noise models, restoration in presence of noise, Inverse filtering, Wiener filtering. Digital image compression- Fundamentals, Redundancies in a digital image, Compression Ratio, Huffman and Run length coding, JPEG standard (overview)

UNIT 4

Image segmentation, representation and description-Point, line and edge detection, Thresholding, Region based segmentation, Overview of Image representation and description (Representation and Descriptors).

Text Books:

1. Rafael C. Gonzales, and Richard E. Woods., "Digital image processing"Pearson education, 2018, 4th edition

References Books:

1. Milan sonka, Vaclav hlavac, Roger Boyle, Broos/colic, "Image processing analysis and machine vision", Thompson Learning, 1999.
2. A.K. Jain, "Fundamentals of Digital image processing", PHI, New Delhi, 1995.

Paper ID: 44727 **L T/P C**

Code: MEES611 **Paper: Environmental Studies** **2 02**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Course Outcomes:

CO 1	Environmental Studies course will provide necessary information and knowledge about the various aspects of environment, ecosystems and related biodiversity.
CO 2	Students will be able to learn and understand about the availability and sustainable use of resources, environmental problems and their short term and long term impacts on humans.
CO 3	Course will help them to learn about environmental policies and protocols, social issues and role of human in conservation and protection of environment.
CO 4	Overall, course will help students to develop skills and ability of understanding environment- human relationship.

Course Outcomes -Program Outcomes Matrix

Filled on a scale of 1 to 3 (3=High; 2=Moderate; 1=Low; '-'for no correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	-	-	-	-	-	1	-	-	-	3	-	-
CO 2	-	-	-	-	-	1	-	-	-	3	-	-
CO 3	-	-	-	-	-	1	-	-	-	3	-	-
CO 4	-	-	-	-	-	1	-	-	-	3	-	-

Unit I: Fundamentals: (8 hours)

The Multidisciplinary nature of environmental studies: Definition, scope and importance, need for public awareness;

Ecosystems: Structure and function of an ecosystem, energy flow in ecosystems, food chain, food web, ecological pyramids, ecological succession; Introduction to types & characteristics

Biodiversity: Introduction to biodiversity-definition, genetics, species, ecosystem diversity, value of biodiversity-consumptive uses, productive, social, ethical, aesthetic and option values, biodiversity at global and national level, hot spots of biodiversity in India, threats to biodiversity, in-situ and ex-situ conservation.

Unit II: Renewable and non renewable resources: (5 hours)

Energy resources: Growing energy needs, renewable and non renewable energy sources, sustainable development

Water Resources: Use and over-utilization of surface and ground water, conflicts over water

Forest resources: Use and over-exploitation, deforestation, case studies

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies

Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture.

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Unit III: Environmental Pollution: (6 hours)

Air Pollution: Types of pollutants, sources, effects & control of air pollutants.
Water Pollution: Classification of Pollutants, their sources, waste water treatment
Soil Pollution: Composition of soil, classification and effects of solid pollutants and their control.
Solid Waste Management: Classification, waste treatment and disposal methods; compositing, sanitary land filling, thermal processes, recycling and reuse methods.
Hazardous wastes - Classification, treatment and disposal processes.
Marine Pollution: Causes, effects and control of marine pollution, coastal zone management.

Unit IV: Environmental Policies, Human Population and Environment (6 hours)

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, Environmental Impact Assessment; Kyoto and Montreal Protocol, Some important Environmental laws, Green bench; population growth and variation among nations, environment and human health, Role of government and non government organizations in environment improvement.

Field work: (equal to 2 hours)

visit to local areas to document environmental assets and study of simple ecosystems.

Suggested Readings and References:

1. A textbook of environmental studies, R.Gadi, S. Rattan, S.Mohaptra, Kataria Publication, 2014.
2. Elements of environmental sciences & engineering, P. Meenakshi, PHI Learning Pvt Ltd, 2014.
3. Basics of Environment and Ecology, A. kaushik& C.P. Kaushik, New Age International Publishers, 2010.
4. Fundamental concepts in environmental studies, D.D. Mishra, S Chand & Co. Ltd., 2008.
5. Textbook of environmental studies, E.Barucha, UGC, 2005.
6. Environmental studies, B. Joseph, Tata McGraw-Hill Publishing Company Ltd., 2005.

Note: This paper is approved by the board of studies of University School of Environment Management.