Annexure

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CURRICULUM

AND

SCHEME OF EXAMINATION

(B.TECH IN COMPUTER SCIENCE & ENGINEERING)

CLOUD COMPUTING(2023-27)

FOREWORD

This is to certify that this booklet contains the entire Curriculum and Scheme of Examination of B.Tech(Computer Science and Engineering) being offered at the Faculty of Engineering and Technology(FET) of this University. This has been duly vetted and finally approved by the Academic Council of the University vide its 43rd meeting held on 5th August 2023 and changes, if any deemed appropriate, shall be duly incorporated after the necessary approval by the Academic Council.

This Curriculum and Scheme of Examination of B.Tech (Computer Science and Engineering) shall be implemented w.e.f. AY 2023-24.

Prof. (Dr.) Brijesh Kumar
Date: **Dean-Academics, MRIIRS**

Preamble:

The Department of Computer Science & Engineering (CSE) focuses on mastering the fundamental concepts both theoretically and practically. The curriculum for the course is geared towards regional, national, and global needs. Keeping in view the growth in industry and increasing demand for computer professionals, some industry associated courses like Mobile Application Programming Using Android, Python, Web development, R programming, Grid Computing, Cloud computing, WEKA, Go Language, SWIFT, Kotline, Blockchain Technology, Internet of Things, and Machine Learning are also included. The courses like professional communication, Quantitative Aptitude and Personality Development, Industrial projects, and Internships facilitate students to cope up with the industrial environment. The course has been designed specifically to address the rising global outlook and focuses on upcoming technologies in the field of Computer Science and Engineering. This aims to cater to the needs of the industry and R&D organizations. Students also practice research by studying Research & Innovation Catalyst (RIC) in different semesters. The curriculum includes Environmental Studies, Constitution of India, Cyberlaw & Ethics. Students get the opportunity to learn various foreign languages French, German, Spanish for their global needs. Also, there is a provision to opt for various MOOC courses.

Curriculum also illustrates the categorization of Regional, National, and Global courses. Courses like Chemistry, Physics, Mathematics, etc. are under the Regional category, courses like Programming for Problem Solving, EVS, etc. are under the National category and the courses like Professional Communication, Machine Learning, etc. fall under the category of Global.

For providing the latest technology updates to the students, regular interactions are in practice with Information Technology organizations like TCS, IBM, Sun Microsystems, L&T, Infosys, HCL, Tech Mahindra, Dell-EMC, R Systems International, etc. The Department has collaborated with IBM to jointly deliver B.Tech (Computer Science & Engineering) programmes with a specialization in Cloud Computing, Business Analytics & Optimization, Cyber Security & Forensics, and Graphics & Gaming. Approximately 25 percent of the credits shall relate to the specific specialization in a particular programme.

The curriculum enumerates Employability, Skill Development, and Entrepreneurship. Courses like Object-Oriented Programming, Database Management Systems, etc. focus on Employability. Courses like Artificial Intelligence, Machine Learning, etc. emphasize Skill Development. Courses like Summer Internship-II, Project, etc. focus on Entrepreneurship. The program provides the distinct categorization on Environment and Sustainability, Professional Ethics and Human Values like EVS, Professional Communication, Cyberlaw & Ethics, etc.

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VISION

MREI is dedicated and committed to train and equip its students with the latest knowledge and skills in the chosen fields in the backdrop of Indian ethos and values to enable them to face any global challenge with a view to transforming them into insightful, honourable and responsible citizens of this great country; and imbibe a work culture of theoretical and applied research leading to creation and dissemination of knowledge.

MISSION

To provide an environment in which teachers love to facilitate and students love to learn, consisting of infrastructure facilities at par with the best institutions in India and abroad with the aim:

- To inculcate skills and impart knowledge to the ignited minds in the fields of science & technology and soft skills including leadership, team-building and communication.
- To create human beings with golden heart, who work and dedicate themselves for the advancement of humanity.
- To undertake research and development activities in collaboration with the world of work leading to creation of new knowledge in the fields of science, commerce, humanities, engineering & technology, management, health sciences & therapies, sports, multi-media, applied & performing arts.

QUALITY POLICY

MRIIRS strives continuously to improve quality of education to nurture the talent of our students to enable them to embark upon a successful career. Our team endeavors to achieve this objective through a proper blend of high conceptual and practical skills supported by excellent infrastructure, teaching methodology and commitment to Quality Management.

VISION OF THE DEPARTMENT

To empower the graduates to be technologically adept, innovative, self-motivated and responsible citizens, possessing human values and contribute significantly towards being a center of excellence in providing globally standard education, through a conducive Teaching and Research environment, that responds swiftly to the challenges of the ever changing world.

MISSION OF THE DEPARTMENT

M1: To achieve academic excellence by imparting in-depth knowledge to the students through effective pedagogies and hands-on experience on the latest tools and technologies.

M2: To pursue interdisciplinary research that will serve the needs of the entire global community.

M3: To prepare students to be continuous learners in a connected world and imbibe professional skills and ethical responsibilities in them.

M4: To strengthen the Industry-Academia interface that will help the graduates to emerge as leaders in academics or an inspiring revolutionary in entrepreneurship.

ABOUT THE DEPARTMENT

The Department of Computer Science & Engineering was established in 1997. The B. Tech Computer Science & Engineering programme offered by the Department had been accredited thrice by the National Board of Accreditation (NBA) in 2003, 2007, and 2018. The Department focuses on mastering the fundamental concepts both theoretically and practically. It motivates for learning, intellectual efficacy, and self-reliance, which provides the best foundation for continuing professional achievement. Master of Technology in Computer Engineering programme provides intensive training to the students at an advanced level to enable them to take up research and development activities. The course curriculum has been specially tailored to fulfill the growing global outlook and focus on upcoming technologies in the field of Computer Science and Engineering to cater to the needs of the industry and R&D organizations. The Faculty members of the Department are actively involved in research and development activities and continuously participating and contributing to National and International Conferences and Seminars. The faculty members of the Department are well published, experienced, conferred with M. Tech/Ph. D degree.

The Department is having several student chapters of the professional bodies like IEEE, CSI, ACM & ISTE. Students are participating in various activities regularly to enhance their technical and interpersonal skills under the banner of these professional societies. The Department also interacts regularly with Information Technology organizations like TCS, IBM, Sun Microsystems, L&T, Infosys, HCL, Tech Mahindra, Dell-EMC, R Systems International, etc. for providing the latest technology updates to the students.

MRIIRS has collaborated with IBM to jointly offer B.Tech-Computer Science & Engineering programmes with a specialization in Cloud Computing, Business Analytics & Optimization, Cyber Security & Forensics, and Graphics & Gaming. The subject matter experts from IBM technology teach the faculty members about the cutting edge technologies through 'Train the Trainer' programmes. IBM provides Learning Management System, Industry Projects for students, Expert Lectures, Industry connectivity for students & teachers to enable them to experience the live IT environment. This partnership help students to acquire domain skills in the most advanced areas of IT and preferential placements by IT companies. Students enrolled in these programmes have access to an online Eco-system Platform namely Innovation Center for Open Standards enabling them to access course material, discussion forums, student projects, industry mentors, and news-clips.

Students enrolled in these programs undertake live projects developed by IBM/other IT majors under the mentorship of industry experts and go for industry visits in software development and testing centers. They also attend a one-week extensive training programme at Bangalore in IBM facilities at their cost in which hands-on training is provided by IBM and other IT company experts. IBM shall also issue certificates for various modules after successful completion in addition to the MRIIRS Degree. The Programmes in association with IBM lead to a big increase in job opportunities and industry readiness for the students.

Approximately 25% of the credits shall relate to the specific specialization in a particular programme and replace certain courses covered under normal B. Tech CSE Programmes.

The Department has also collaborated with other leading industries to give exposure to the students. TCG Digital solutions private Limited will set up a virtual Cyber Security platform lab for training the students in the area of cybersecurity. The Department also has collaborations with Infosys, Dell-EMC & R-Systems International Ltd. These collaborations help the students to work on the technologies which are currently being used in the industry.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Department of Computer Science and Engineering (CSE), in consultation with various stakeholders, has formulated the Programme Educational Objectives (PEOs). These are broad statements describing the career and professional accomplishments of the graduates, that the programme is preparing them to achieve, after receiving the degree. The PEOs of the B. Tech Programme in Computer Science and Engineering are as follows:

PEO1 - Graduates will exhibit technical proficiency and leadership to become qualified engineers paving the way for a prosperous career in industry, consultancy, education, and allied areas related to the subjects of Computer Science and Engineering**.**

PEO2 - Graduates will commit to sustainable development, identify the real-life gaps and mobilize the requirements, and propose an innovative solution while maintaining ethical, professional, and social obligations.

PEO3 - Graduates will continue their education throughout their lives thereby creating and disseminating knowledge based on research and challenging problem-solving strategies.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems anddesign system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and researchmethods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutionsin societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms ofthe engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineeringcommunity and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of theengineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Engineering Graduates will be able to:

1. **Legacy Software:** Upgrade and maintain legacy software systems by using modern techniques, programming

skills, and tools.

2. **Development of Software Systems:** Develop, test and maintain Software systems for business and other applications, that meets the automation needs of the society and industry.
3. **Research and Development**: Cultivate the field of computing and its latest trends, to pursue teaching, research & development activities and to work effectively in a team.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES TO PROGRAM OUTCOMES

POs / PEOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
PEO 1	3	3	2	2	2	1	1	1	2	2	3	2	3	3	2
PEO 2	2	3	3	3	2	1	1	1	3	2	2	3	2	2	3
PEO 3	3	3	2	3	3	1	1	1	2	3	2	2	3	3	3

Semester system and Choice Based Credit System (CBCS)

A credit-based system of study and students' performance/progress is measured by the number of credits that he/she has earned, i.e. completed satisfactorily. Based on the course credits and grades obtained by the student, the grade point average is calculated.

(a) Course credits assignment

Each course has a certain number of credits assigned to it depending upon its duration in periods for a lecture, tutorial, and laboratory/clinical practice in a week. A few courses/activities are without credit (s) and are referred to as Audit Pass Courses (APC) but are mandatory to pass as partial fulfillment of the award of a degree.

(b)Earning of Credits

At the end of every course, a letter "Grade" shall be awarded in each course for which a student has registered. On obtaining a minimum Pass Grade, the student shall accumulate the course credits as Earned Credits. A student's performance shall be measured by the number of credits that he/she has earned and by the weighted grade point average. Grades obtained in the audit courses shall not be counted for computation of grade point average, however, shall be mandatory to pass as partial fulfillment of the award of a degree.

For the Award of Degree of a Programme B.Tech in Computer Science and Engineering, he/she has to earn a minimum of 160 credits during the 4-year duration of the programme in 8-semesters. The total credits required to be earned have been further classified under two baskets of courses: "Compulsory Courses Basket (CBB)", and "Elective Courses Basket (ECB)". A total of 122.5 credits are required to be earned under CBB and 37.5 credits under ECB.

All courses under CBB are required to be qualified and cleared/pass by every student enrolled under the programme and are semester-wise listed in the study scheme along with the credits assigned to each course.

Under Elective Courses Basket (ECB), there will be three types of courses:

- Semester-wise courses offered by the department itself
- Open/Inter-disciplinary courses offered at the Institute/University level notified from the office of Dean-Academics.
- Massive Open Online Courses (MOOCs) available on Study Webs of Active-Learning for Young Aspiring Minds (SWAYAM)Platform or any other platform as recommended by UGC/AICTE and notified from the office of Dean-Academics.

Each course shall have credits assigned to it. The student shall be required to register courses every semester for as many courses/credits specified under the "Elective Courses Basket" depending upon his/her interest, capability/pace of learning, and availability of time slot (without any clash in time table) to earn all required total credits under the "Elective Courses Basket" during the entire programme duration.

However, for registration of courses [including courses under "Compulsory Courses Basket", "Elective Courses Basket" and Previous Semester Courses (wherein he/she was declared ineligible based on attendance or he/she could not clear the course within permissible given chances)], if any, the maximum limit in a semester shall be 30 credits.

Study Scheme of B.Tech CSE-CC

SEMESTER-I														
(Common for All B.Tech. Programmes)														
Course Type	Course Code	Title of Course	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Evaluation Continuous	End Semester Evaluation	Total		
Compulsory Courses													
BSC	BPH-106	Physics for Engineers	NA	NA	3+1 #	0	0	4	100	100	200	3 hrs	3
BSC	BMA-101	Mathematics-I	NA	NA	3+1 #	1	0	5	100	100	200	3 hrs	4
ESC	BEE-103	Basic Electrical and Electronics Engineering (Group A)	NA	NA	3	0	0	0	100	100	200	3 hrs	3
ESC	BCS-100 A	AI For Engineers	NA	NA	2	0	0	2	100	100	200	3 hrs	2
ESC	BME-101A	Engg Graphics & Design	NA	NA	0	0	4	4	100	100	200	3 hrs	2
BSC	BPH-151A	Physics lab	NA	NA	0	0	2	2	50	50	100	2 hrs	1
ESC	BEE-151A	Basic Electrical Engg lab	NA	NA	0	0	2	2	50	50	100	2 hrs	1
HSMC	CDC-PC-101	Professional Communication - I	NA	NA	2	0	0	2	50	50	100	2 hrs	2
HSMC	BHM-MC-001	Constitution of India*	NA	NA	0	1	0	1	50	50	100	2 hrs	AP
		Total			**15**	**3**	**8**	**26**	**700**	**700**	**1400**	**23**	**18**

9# Contact hours per week have been increased due to bridge course.

(Common for All B.Tech. Programmes) B.tech (Non-CSE branches and CSE N): Group A & B.tech CSE (SPL): Group B

SEMESTER-II

Course Type	Subject Code	Subject	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Evaluation Continuous	End Semester Evaluation	Total		
Compulsory Courses													
BSC	BCH-106	Chemistry for Engineers	NA	NA	2+1 #	0	0	3	100	100	200	3 hrs	2
BSC	BMA-201	Mathematics-II	NA	NA	3	1	0	4	100	100	200	3 hrs	4
ESC	BCS-101A	Programming for Problem Solving	NA	NA	3	0	0	3	100	100	200	3 hrs	3
BSC	BBT-100A	Biology for Engineers	NA	NA	2	0	0	2	100	100	200	3 hrs	2
ESC	BME-102	Workshop/Manufacturing Practices	NA	NA	0	0	4	4	100	100	200	2 hrs	2
BSC	BCH-151A	Chemistry lab	NA	NA	0	0	2	2	50	50	100	2 hrs	1
ESC	BCS-151A	Programming for Problem Solving lab	NA	NA	0	0	2	2	50	50	100	2 hrs	1
HSMC	CDC-PC-102	Professional Communication - II	NA	NA	2	0	0	2	50	50	100	2 hrs	2
HSMC	BCH-MC-002	EVS**	NA	NA	0	1	0	1	50	50	100	2 hrs	AP
		Total			**11**	**2**	**10**	**23**	**700**	**700**	**1400**	**22**	**16**

NOTE: Contact hours per week have been increased due to bridge course.

SEMESTER- III													
Course Type	**Course Code**	**Title of Course**	**Pre-requisite Course, if any**		**Periods/Week**				**Marks**			**Duration of Exam**	**Credits**
			Title	**Code**	**L**	**T**	**P**	**Total**	**Int./ Continuous**	**End Sem.**	**Total**		
Compulsory Courses													
CORE	BCS-DS-301	Data Structure & Algorithms	NIL		3	1	0	4	100	100	200	3Hrs	4
ESC	BEC-DS-322	Digital Electronics and Circuits	NIL		3	0	0	3	100	100	200	3Hrs	3
CORE	BCS-DS-302A	Object Oriented Programming	NIL		2	1	0	3	100	100	200	3Hrs	3
HSMC	BHM-001A	Cyber law & Ethics	NIL		2	0	0	2	100	100	200	3Hrs	2
BSC	BMA-303A	Mathematics-III	NIL		2	1	0	3	100	100	200	3Hrs	3
CORE	BCS-DS-351	Data Structure & Algorithms Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
ESC	BEC-DS-362	Digital Electronics and Circuits Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
CORE	BCS-DS-352	Object Oriented Programming Lab	NIL		0	0	2	2	50	50	100	2 hrs	1
HSMC	DTI-300	Design Thinking & Innovation-I	NIL		0	1	0	1	50		50		1
HSMC	BHM-MC-002	Sports and Yoga	NIL		2	0	0	2	100		100	1hrs	AP
HSMC	BHM-MC-004	Quantitative Aptitude	NIL		0	0	2	2	50	50	100	2 hrs	AP
PROJ	PROJ-CS-300A	Summer Internship –I	NIL		2weeks Minimum				50		50	2 hrs	1
CORE	BCS-DS-527	CLOUD COMPUTING ARCHITECTURE AND DEPLOYMENT MODEL	NIL		2	0	0	2	100	100	200	3hrs	2
CORE	BCS-DS-579	CLOUD COMPUTING ARCHITECTURE AND DEPLOYMENT MODEL LAB	Cloud Computing Architecture and Deployment Models (BCS-DS-527)		0	0	2	2	50	50	100	2 hrs	1
TOTAL					16	3	10	29	1150	1150	2200	30HRS	22
Elective Courses *													
Domain specific CC	BCS-DS-376	Azure Data Fundamentals			0	0	4	4	50	50	100	2Hrs	2

	BCS-DS-374	Security Compliance and Identity Fundamental Azure			0	0	4	4	50	50	100	2 hrs	2

* Under Elective Courses, Inter-disciplinary, Generic, on-line Courses (MOOCs etc) and other approved courses shall be offered, which shall be notified well before start of the semester. The student shall be required and allowed to opt the courses out of offered courses as per prescribed limit for maximum credits(28) in a semester and for the category of Elective Courses under University Rules.

SEMESTER- IV

Course Type	Course Code	Title of Course	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Int./ Continuous	End Sem.	Total		
Compulsory Courses													
CORE	BCS-DS-401	Discrete Mathematics	NIL		3	1	0	4	100	100	200	3Hrs	4
CORE	BCS-DS-402	Computer Organization & Architecture	NIL		3	0	0	3	100	100	200	3Hrs	3
CORE	BCS-DS-403	Operating Systems	NIL		3	1	0	4	100	100	200	3Hrs	4
CORE	BCS-DS-404	Database Management Systems	NIL		3	1	0	4	100	100	200	3Hrs	4
CORE	BCS-DS-405	Computer Networks	NIL		3	0	0	3	100	100	200	3Hrs	3
CORE	BCS-DS-451	Operating Systems Lab	NIL		0	0	2	2	50	50	100	2Hrs	1
CORE	BCS-DS-452	Database Management Systems Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
CORE	BCS-DS-453	Computer Networks Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
HSMC	DTI-400	Design Thinking & Innovation-II	NIL		0	1	0	1	50		50		1
HSMC	BHM-320	Universal Human Values 2: Understanding Harmony			1	1	0	2	50	50	100	2 Hrs	2
HSMC	BHM-MC-006	Quantitative Aptitude and Personality Development-I	NIL		0	0	2	2	50	50	100	2 hrs	AP
TOTAL					16	5	8	29	750	700	1450	25HRS	24
Elective Courses *													
Domain Specific (CC)	BCS-DS-489	Azure Developer Associate			0	0	4	4	50	50	100	2 Hrs	2
	BCS-DS-490	Azure Database Administrator Associate			0	0	4	4	50	50	100	2 Hrs	2
	BCS-DS-406	Introduction to Virtualization and Cloud Computing (CC)	NIL		2	0	0	2	100	100	200	3 Hrs	2
	BCS-DS-454	Virtualization Lab (CC)	NIL		0	0	2	2	50	50	100	2 Hrs	1
Domain Specific	BCS-DS-422	Open Source Software	NIL		3	0	0	3	100	100	200	3Hrs	3

	BCS-DS-423	Cloud Computing	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-475	Cloud Computing Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-427A	Python	Object Oriented Programming	BCS-DS-302A	2	0	0	2	100	100	200	3Hrs	2
	BCS-DS-479A	Python Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-428	Blockchain Technology	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-481	Blockchain Technology Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-430	Software Engineering and Project Management	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-482	Mobile Application Development Lab	NIL		0	0	4	4	50	50	100	2 Hrs	2
	BCS-DS-472	Web development II	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-473	Programming using R	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-478	XML based Lab	NIL		0	0	4	4	50	50	100	2 Hrs	2
	BCS-DS-450	Springboot	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-491	Springboot Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-455	Interface Design for HCI	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-492	Interface Design for HCI Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-456	Augmented Reality & AR Core	NIL		3	0	0	3	100	100	200	3Hrs	3

* Under Elective Courses, Inter-disciplinary, Generic, on-line Courses (MOOCs etc) and other approved courses shall be offered, which shall be notified well before start of the semester. The student shall be required and allowed to opt the courses out of offered courses as per prescribed limit for maximum credits(28) in a semester and for the category of Elective Courses under University Rules.

SEMESTER- V													
Course Type	**Course Code**	**Title of Course**	**Pre-requisite Course, if any**		**Periods/Week**				**Marks**			**Duration of Exam**	**Credits**
			Title	**Code**	**L**	**T**	**P**	**Total**	**Int./ Continuous**	**End Sem.**	**Total**		
Compulsory Courses													
CORE	BCS-DS-501	Design & Analysis of Algorithms	Data Structure & Algorithms	BCS-DS-301	3	1	0	4	100	100	200	3Hrs	4
CORE	BCS-DS-502	Formal Language & Automata Theory	NIL		3	1	0	4	100	100	200	3Hrs	4
CORE	BCS-DS-503	Artificial Intelligence	NIL		3	0	0	3	100	100	200	3Hrs	3
CORE	BCS-DS-551	Design & Analysis of Algorithms Lab	Data Structure & Algorithms Lab	BCS-DS-351	0	0	2	2	50	50	100	2 Hrs	1

CORE	BCS-DS-552	Artificial Intelligence Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
PROJ	PROJ-CS-500**	Summer Internship-II	NIL		4 weeks Minimum				100		100	2 hrs	2
HSMC	DTI-500	Design Thinking and Innovation - III	NIL		0	1	0	1	50		50		2
HSMC	BHM-MC-008	Quantitative Aptitude and Personality Development-II	NIL		0	0	2	2	50	50	100	2 Hrs	AP
HSMC	BHM-520	Entrepreneurship and Startups	NIL		2	0	0	2	100	100	200	3Hrs	2
CORE	BCS-DS-609	CONTAINER ORCHESTRATION AND INFRASTRUCTURE INFORMATION	CCADM		3	0	0	3	100	100	200	3 Hrs	3
CORE	BCS-DS-657	CONTAINER ORCHESTRATION AND INFRASTRUCTURE INFORMATION LAB	CONTAINER ORCHESTRATION AND INFRASTRUCTURE INFORMATION		0	0	2	2	50	50	100	2Hrs	1
TOTAL					14	3	8	25	900	750	1650	25HRS	**23**
Elective Courses *													
Domain Specific(CC)	BCS-DS-590	Azure Security Engineer Associate			0	0	4	4	50	50	100	2 Hrs	2
	BCS-DS-591	Azure Network Engineer Associate			0	0	4	4	50	50	100	2 Hrs	2
	BCS-DS-504	Business Intelligence (CC, BA)	NIL		3	0	0	3	100	100	200	3 Hrs	3
	BCS-DS-553	Business Intelligence Lab (CC, BA)	NIL		0	0	2	2	50	50	100	2 Hrs	1
Domain Specific	BCS-DS-521	Computer Graphics	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-571	Computer Graphics Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-474A	Java Programming	Object Oriented Programming	BCS-DS-302A	3	0	0	3	100	100	200	3 Hrs	3
	BCS-DS-572	Dot Net	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-573	Visual Basics	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-575	Go Language	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-576	SWIFT	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-577	Kotline	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-522A	Software Development Processes	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-578A	Software Development Processes Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1

	BCS-DS-523	Management Information System	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-524	Knowledge Based Systems	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-525	System Analysis and Design	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-531	Data Warehouse	Database Management Systems	BCS-DS-404	3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-507	UI/UX	NIL		0	0	4	4	100	100	200	3Hrs	2
	BCS-DS-543	Enterprise Java	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-544	React JS	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-545	Kubernetes Application Development	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-546	Docker Application Development	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-547	Genomic Data Science	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-594	Genomics Data Science Lab	NIL		0	0	2	2	50	50	200	2Hrs	1
	BCS-DS-548	GPU Programming	NIL		3	0	0	3	100	100	200	3Hrs	3
Generic Elective I													
Generic Elective	HM 506	French I	NIL		2	0	0	2	50	50	100	1.5 Hrs	2
	HM 507	German I	NIL		2	0	0	2	50	50	100	1.5 Hrs	2
	HM 508	Spanish I	NIL		2	0	0	2	50	50	100	1.5 Hrs	2

*** Under Elective Courses, beside the mentioned Domain Specific Elective Courses, other Inter-disciplinary, Generic, on-line Courses (MOOCs etc) and other approved courses shall be offered, which shall be notified well before start of the semester. The student shall be required and allowed to opt the courses out of offered courses as per prescribed limit for maximum credits(28) in a semester and for the category of Elective Courses under University Rules.**

****Training undertaken by students during the Summer vacation after fourth Semester(4 weeks minimum) will be evaluated as a V Semester subject.**

SEMESTER- VI													
Course Type	**Course Code**	**Title of Course**	**Pre-requisite Course, if any**		**Periods/Week**				**Marks**			**Duration of Exam**	**Credits**
			Title	**Code**	**L**	**T**	**P**	**Total**	**Int./ Continuous**	**End Sem.**	**Total**		
Compulsory Courses													
PROJ	PROJ-CS-600	Project Phase I	NIL		0	0	2	2	50		50		1
HSMC	BHM-MC-009	Quantitative Aptitude and Personality Development-III	NIL		0	0	2	2	50	50	100	2 Hrs	AP
CORE	BCS-DS-626	Managing the Cloud (CC)	NIL		3	0	0	3	100	100	200	3 Hrs	3
CORE	BCS-DS-677	Managing the Cloud Lab (CC)	NIL		0	0	2	2	50	50	100	2 Hrs	1
CORE	BCS-DS-612	Cloud application development	All cc subjects		3	0	0	3	100	100	200	3 hrs	3
CORE	BCS-DS-662	Cloud application development LAB	Cloud application development		0	0	2	1	50	50	100	2HRS	1
TOTAL					**6**	**0**	**8**	**13**	**400**	**350**	**750**	**12HRS**	**09**
Elective Courses *													

	BCS-DS-690	Identity and Access Administration Associate			0	0	4	4	50	50	100	2 Hrs	2
	BCS-DS-691	Azure Solutions Architect Expert			0	0	4	4	50	50	100	2 Hrs	2
Domaic Specific(CC)	BCS-DS-310	DISTRIBUTED COMPUTING	NIL		3	0	0	3	100	100	200	3 Hrs	3
	BCS-DS-625	Data Warehouse and Data Mining	Nil		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-601	Backup & Disaster Recovery (CC)	NIL		3	0	0	3	100	100	200	3 Hrs	3
	BCS-DS-602	Machine Learning	NIL		3	1	0	4	100	100	200	3Hrs	4
	BCS-DS-652	Machine Learning Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-603	Internet of Things (IOT)	NIL		3	1	0	4	100	100	200	3Hrs	4
DOMAIN SPECIFIC	BCS-DS-653	Internet of Things (IOT) Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-621	Software Testing And Quality Assurance	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-622A	Advance Data Base Management Systems	Database Management Systems	BCS-DS-404	3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-671A	Advance Data Base Management Systems Lab	Database Management Systems Lab	BCS-DS-452	0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-624	Complier Design	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-673	Complier Design Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-676	Web Development Framework	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-632	Data Mining	Database Management Systems	BCS-DS-404	3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-682	Data Mining Lab using WEKA	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-647	Computing Service: Eclipse	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-648	Digital Service Innovation	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-649	Cognitive Modelling	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-650	Ubiquitous Computing	NIL		3	0	0	3	100	100	200	3Hrs	3

Generic Elective II													
Generic Elective	HM 606	French II	NIL		2	0	0	2	50	50	100	1.5 Hrs	2
	HM 607	German II	NIL		2	0	0	2	50	50	100	1.5 Hrs	2
	HM 608	Spanish II	NIL		2	0	0	2	50	50	100	1.5 Hrs	2

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SEMESTER- VII													
Course Type	**Course Code**	**Title of Course**	**Pre-requisite Course, if any**		**Periods/Week**				**Marks**			**Duration of Exam**	**Credits**
			Title	**Code**	**L**	**T**	**P**	**Total**	**Int./ Continuous**	**End Sem.**	**Total**		
Compulsory Courses													
PROJ	PROJ-CS-700	Project Phase - II/Industrial Project	NIL		0	0	10	10	200	100	300	2 hrs	5
PROJ	PROJ-CS-710	Summer Internship-III	NIL		0	0	2	2	100	100	200	2hrs	2
CORE	BCS-DS-707	DEVOPS	CCADM		2	0	0	2	100	100	200	3 Hrs	2
CORE	BCS-DS-754	DEVOPS Lab (CC)	CCADM lab		0	0	2	2	50	50	100	2 Hrs	1
TOTAL					**2**	**0**	**14**	**16**	**450**	**350**	**800**	**9HRS**	**10**
Elective Courses *													
Domai 2n Specific(CC)	BCS-DS-781	Cyber security Architect Expert			0	0	4	4	50	50	100	2Hrs	2
	BCS-DS-782	DevOps Engineer Expert			0	0	4	4	50	50	100	2 Hrs	2
	BCS-DS-701	Security in Cloud (CC)	Cloud Computing Architecture and Deployment Models (CC)	BCS-DS-527	3	0	0	3	100	100	200	3 Hrs	3
	BCS-DS-731	Introduction to IoT (CC)	NIL		2	0	0	2	100	100	200	3 Hrs	2
	BCS-DS-773	Introduction to IoT Lab (CC)	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-730	Big Data Analytics (CC, BA)	Database Management Systems	BCS-DS-404	3	0	0	3	100	100	200	3 Hrs	3

	BCS-DS-772	Big Data Analytics Lab (CC, BA)	NIL		0	0	2	2	50	50	100	2 Hrs	1
Domain specific	BCS-DS-721	Simulation and Modelling	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-771	Simulation and Modelling Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
	BCS-DS-734	Automation and Robotics	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-723	Parallel and Distributed Algorithms	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-724	Advanced Computer Networks	Computer Networks	BCS-DS-405	3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-725	Network Security & Management	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-726	Distributed Operating System	Operating Systems	BCS-DS-403	3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-727	Data Science	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-728	Soft Computing	NIL		3	0	0	3	100	100	200	3Hrs	3

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SEMESTER- VIII													
Course Type	**Course Code**	**Title of Course**	**Pre-requisite Course, if any**		**Periods/Week**				**Marks**			**Duration of Exam**	**Credits**
			Title	**Code**	**L**	**T**	**P**	**Total**	**Int./ Continuous**	**End Sem.**	**Total**		
Compulsory Courses													
PROJ	PROJ-CS-800	Internship –III			24 weeks				200	100	300	2 hrs	10
OR													
Elective Courses *													
Domain Specific	BCS-DS-822	Fuzzy Theory	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-823	Computational Linguistics and Natural Language Processing	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-824	Cryptography and Network Security	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-825	Machine Learning with Big Data	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-872	Machine Learning with Big Data LAB	NIL		0	0	2	2	50	50	100	2 Hrs	1

	BCS-DS-826	Wireless and AD-Hoc Network	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-827	Advanced Computer Architecture	Computer Organization & Architecture	BCS-DS-402	3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-828	Neural Networks and Deep Learning	NIL		3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-829	Advanced Data Warehouse and Data Mining	Data Warehouse & Data Mining	BCS-DS-531 & BCS-DS-632	3	0	0	3	100	100	200	3Hrs	3
	BCS-DS-830	Grid Computing	NIL		3	0	0	3	100	100	200	3Hrs	3

*** Under Elective Courses, beside the mentioned Domain Specific Elective Courses, other Inter-disciplinary, Generic, on-line Courses (MOOCs etc) and other approved courses shall be offered, which shall be notified well before start of the semester. The student shall be required and allowed to opt the courses out of offered courses as per maximum limit for maximum credits (28)and for the category of Elective Courses under University Rules.**

SEMESTER – I

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

NAAC 'A++' Grade University

BPH-106: PHYSICS FOR ENGINEERS

Periods/week		Credits	Max. Marks	: 200
L: 3	T:0	3	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs			End Term Examination	: 100

Pre-requisite: Basic knowledge of 10+2 level Physics
Course Type: Basic Sciences

Course Outcomes: The students will be able to:

BPH-106.1 discuss and explain the key concepts and principles of quantum physics, lasers and optical fibres
BPH-106.2 apply the basic concepts of semiconductors and devices based on them
BPH-106.3 analyze the structure, characterization techniques and applications of advanced material.
BPH-106.4 recall the basic concept of electromagnetism and understand their applications to the theoryof electromagnetic waves.

Unit-1 Semiconductors (8 Lectures)

Physical properties of semiconductors, direct and indirect band gap semiconductors, compound semiconductors, organic and inorganic semiconductors, Fermi level and Fermi energy, occupation probability, concentration of charge carriers, generation and recombination, carrier transport: drift and diffusion, energy band diagram of unbiased and biased P N Junction, Light Emitting Diode, Photodetectors - p-n photodiode, PIN, Photoconductivity, Effect of impurity & Traps, Photovoltaic effect and Solar cell.

Unit-2 Quantum Physics (8 Lectures)

Limitations of classical physics, Black-body radiations, Planck's hypothesis, Photo-electric effect, Compton effect, Uncertainty principle, Matter waves, Phase and group velocity, Schrodinger's equations (time dependent and independent), Particle in a box (motion in one dimension), Basics of quantum statistics.

Unit-3 Lasers and Optical Fibres (8 Lectures)

Introduction to laser, Spontaneous and stimulated emissions of radiations, Einstein's coefficients and relation among them, Population inversion and laser pumping, Characteristics of lasers, Components of laser, He-Ne laser, Semiconductor laser, Applications of laser.

Introduction to optical fibres, Acceptance angle and acceptance cone, Numerical aperture, Classification of fibres, Attenuation, Losses associated with optical fibres, Merits and applications of optical fibres.

UNIT 4: Advance Material and Synthesis (6 Lectures)

Introduction to nanomaterials, Nano-science and nano-technology, Two main approaches in nanotechnology, Bottom up technique, Top down technique, Quantum dot and graphene, Methods to produce Nanomaterials, Chemical vapour deposition, Sol-gel process, Molecular beam epitaxy, Physical and chemical properties of nanomaterials, Carbon nanotubes: single and multi-walled nanotubes, Synthesis of Nanotubes: carbon arc method, Laser evaporation method, Sputtering, applications of advanced materials.

UNIT 5: Investigating Techniques (6 Lectures)

Properties of X-Ray,Braggs' Law, Bragg's Spectrometer, Rutherford Back Scattering, Raman effect and Raman spectroscopy, Hall effect, Vander Pauw measurements for carrier density, resistivity, Hot-point probe measurement, AFM, SEM, photoluminescence spectroscopy, band gap by UV-Vis spectroscopy.

Unit-6 Electrodynamics (8 Lectures)

Divergence and curl of electrostatic field, Laplace's and Poisson's equations for electrostatic potential. Solutions of Laplace equation in one dimension, Dielectric Polarization and Dielectric constant, Piezoelectricity, Bio-Savart law and Ampere's circuital theorem, Continuity equation for current densities, Displacement current, Maxwell's equations, Electromagnetic energy – Flow of energy and Poynting vector, The wave equation; Plane electromagnetic waves in vacuum, their transverse nature, Energy carried by electromagnetic waves.

Text Books/ Reference Books:

1. P. Bhattacharya,2017, Semiconductor Optoelectronic Devices, Pearson education.
2. D.J Griffiths, 2015, Introduction to Electrodynamics, Pearson education.
3. Avadhanulu and Kshirsagar,2014, A textbook of Engineering Physics S. Chand.
4. S.P. Taneja,2018, Modern Physics for Engineers, R. Chand & Co.
5. Mark Ratner and Daniel Ratner, 2003,Nanotechnology, Pearson.
6. M.N.O. Sadiku, 2015, Elements of Electromagnetics, Asian Edition, Oxford Higher Education.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Assignments, Sessional and End Semester Examination paper will consist of various difficulty levels to accommodate the different capabilities of students. Assessment should cover all course outcomes and upper limit for lower order skills will be 40% (for knowledge-oriented questions). However, weightage for different cognitive levels in the question papers can vary.

Instructions for paper setting: The paper setter must ensure the coverage of entire syllabus while setting the question papers and mention the learning outcomes across each section to be measured by the examination. Weightage of the sections may vary as per the number of respective lecture hours mentioned in the syllabus.Action verbs should be used from Bloom’s Taxonomy while designing question papers.

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
BPH-106.1	2	2	1	2	3	-	-	-	-	-	2	--	--	--
BPH-106.2	3	1	3	-	2	1	1	-	-	-	-	--	--	--
BPH-106.3	3	2	2	-	2	2	1	-	-	-	-	--	--	--
BPH-106.4	3	3	3	1	1	3	1	-	-	-	-	--	--	--

BMA-101: Mathematics- I

Periods/week	Credits	Max. Marks : 200
L: 3 T: 1	4	Continuous Evaluation : 100
Duration of Examination: 3 Hrs		End Sem Examination : 100

Pre-requisites: The students must have the knowledge of mathematical concepts of Intermediate level.
Course Type: Basic Sciences

Course Outcomes: Students will be able to-
BMA-101.1. Draw the role of mathematics which allows both algebraic and graphical representations of a function.
BMA-101.2. Define the terminology of Integration, Differential Equations, Matrices and Vectors
BMA-101.3. Explain improper integrals, power series, linear system of equations and vector space.
BMA-101.4. Use the knowledge of Beta and Gamma Functions, rank of matrices, expansion of functions and diagonalization.
BMA-101.5. Apply the concepts of integration, differentiation, matrices and vectors to solve real life problems.
BMA-101.6. Find the surface area and maxima and minima of a function.

PART-A

Unit 1: Integral Calculus:
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 2: Differential Calculus:
Rolle's theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders, indeterminate forms and L'Hospital's rule, Maxima and minima.

Unit 3: Matrices:
Matrices, Vectors: addition and scalar multiplication, matrix multiplication, Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

PART-B

Unit 4: Vector Spaces-I
Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, Rank-Nullity theorem, composition of linear maps, Matrix associated with a linear map.

Unit 5: Vector spaces-II
Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization, inner product spaces, Gram-Schmidt Orthogonalization.

Text Books/Reference Books:
1. G.B. Thomas and R.L. Finney, 2002, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint.
2. Erwin kreyszig, 2006, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
3. Veerarajan T.,2008, Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
4. Ramana B.V.,2010, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint.
5. D. Poole, 2005, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole.
6. N.P. Bali and Manish Goyal, 2008, A textbook of Engineering Mathematics, Laxmi Publications, Reprint.
7. B.S. Grewal, 2010, Higher Engineering Mathematics, Khanna Publishers, 36th Edition.
8. V. Krishnamurthy, V.P. Mainra and J.L. Arora, 2005, An introduction to Linear Algebra, Affiliated East–West press.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B. Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%

Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Semester Examination.

Course Articulation Matrix:

CO Statement (BMA-101)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**P O 12**	**PS O 1**	**PS O 2**	**PS O 3**
BMA-101.1	3	3	1	2	2	--	--	--	--	--	--	2	--	--	--
BMA-101.2	3	3	1	2	2	--	--	--	--	--	--	1	--	--	--
BMA-101.3	3	3	2	2	3	--	--	--	--	--	--	2	--	--	--
BMA-101.4	3	2	1	1	2	--	--	--	--	--	--	1	--	--	--
BMA-101.5	3	3	2	2	3	--	--	--	--	--	--	2	--	--	--
BMA-101.6	3	3	2	1	3	--	--	--	--	--	--	2	--	--	--

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-103: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Periods/week Credits		Max. Marks	: 200
L: 3 T:0	3	Continuos Evaluation	: 100
Duration of Examination: 3 Hours		End Semester Exam	: 100

Pre-requisites
Course Type: Engineering Science

Course Outcomes: After completion of this course the students will be able to
BEE-103.1 understand the basic electrical laws, theorems, components of electrical system, earthing and working of batteries.
BEE-103.2 apply the basic theorems and laws for solving both dc and ac networks.
BEE-103.3 learn the construction and working of transformers and electrical machines
BEE-103.4 understand the working of semiconductor devices and digital circuits

PART-A

Unit 1: DC CIRCUITS (8 hours)
1.1 Electrical circuit elements (R, L and C), voltage and current sources,
1,2 Kirchoff Voltage and Current Laws,
1.3 Analysis of simple circuits (two loops) with dc excitation ,
1.4 Superposition Theorem,
1.5 Thevenin's Theorem,
1.6 Norton's Theorem,
1.7 Time domain analysis of first order system- RL circuit,
1.8 Time domain analysis of first order system- RC circuit.

Unit 2: AC CIRCUITS (7 hours)
2.1 Single Phase-AC Generation,
2.2 Sinusoidal Waveform- peak value average and rms values
2.3 Phasor representation, L, C, RL, RC circuit
2.4 RLC Series Circuits
2.5 Power factor, Real power, Reactive power and Apparent power
2.6 Resonance
2.7 Three Phase Emf Generation, Delta and Star Connections
2.8 Voltage and current relation in star and delta connections

Unit 3: TRANSFORMERS AND ELECTRICAL MACHINES (7 hours)
3. 1Working Principle, Construction and Emf Equation of transformer
3.2 Ideal and Practical transformer,
3.3 Losses and Efficiency of transformer
3.4 Construction and working of DC motor and generator
3.5 Speed Control of Dc shunt motor
3.6 Construction and working of a three-phase induction motor
3.7 Single-phase induction motor working and types

PART-B

Unit 4: SEMICONDUCTOR DEVICES (6 hours)
4.1 Power semiconductor devices- power diodes, Bipolar transistor,
4.2 Field Effect transistor, MOSFET, IGBT
4.3 SCR-VI characteristics, and gate characteristics
4.4 Introduction to Power Converters -Diode rectifier, controlled rectifier
4.5 Inverter, DC to DC converters

Unit 5: DIGITAL CIRCUITS (7 hours)
5.1 Number systems,
5.2 conversion of bases (Binary, Decimal, Hexa, Octal),
5.3, Basic logic gates, AND OR, NAND , NOR –truth tables
5.4 Boolean algebra,

5.5 De Morgan's theorem
5.6 Introduction to flip-flops SR,JK, D type,
5.7 Introduction to Counters and Shift registers

Unit 6: ELECTRICAL INSTALLATIONS and BATTERIES (5 hours)
6.1 Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB,
6.2 Necessity and Standards of earthing, Methods of Earthing
6.3 Types of Batteries, capacity and efficiency (ampere hour and watt hour)
6.4 Working of Lead Acid Battery, Charging and Discharging
6.5 Working of Nickel Cadmium battery
6.6 Working of Lithium Ion Battery

Text Books/ Reference Books:

1 J. Nagrath, D. P. Kothari ,2007, Basic Electrical Engineering, TMH.
2 S. Nath Chakrabarti, C. K. Chanda , 2009, Basic Electrical Engineering, TMH,2009.
3 B. L. Thereja , 2005, Electrical Technology Vol.1, S Chand.
4 S K Sahadev ,2015, Basic Electrical Engineering, Pearson India
5 V. N. Mittal, Aravind Mittal, 2007, Basic Electrical Engineering, TMH 2007.
6 Santiram Kal, 2002, Basic Electronics- Devices, Circuits and it Fundamentals, Prentice Hall, India.
7 T. L. Floyd (2017), Digital Fundamentals, Pearson Education.
8 H. C. Rai, (2018) Power Electronics and Industrial Applications, CBS Publications
9 S.M. Sze, M.K. Lee, (2015), Semiconductor Devices, Physics and Technology, Wiley
10 V K Mehta, R Mehta 2014, Principles of Electronics, S Chand.

Software required/Weblinks
https://nptel.ac.in/courses/108105112
https://nptel.ac.in/courses/108108076/
https://nptel.ac.in/courses/108106181
https://nptel.ac.in/courses/108105113

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B. Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Se Sessional- I	3 30%
Se Sessional- II	3 330%
A Assignment	2 20%
C Class Performance	1 10%
At Attendance	1 10%

COURSE ARTICULATION MATRIX for CSE

	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO	PSO
BEE-	3	3	2	1	2	-	-	-	-	-	-	2	2	3	2
BEE-103.2	3	3	3	1	2	-	-	-	-	-	-	2	2	3	2
BEE-103.3	3	3	3	1	2	-	-	-	-	-	-	2	2	3	2
BEE-103.4	3	3	3	1	2	-	-	-	-	-	-	2	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A++' Grade University

BCS-100A: Artificial Intelligence for Engineers

Periods/week	Credits	Max. Marks : 200
L :2 T: 0	2.0	Continuous Assessment : 100
Duration of Exam: 3 Hrs		End Term Examination : 100

Pre-Requisite: Nil
Course Type: Engineering Science Course

Course Outcomes: The Students will be able to-
BCS-100A.1 understand evolution of Artificial Intelligence.
BCS-100A.2 familiarize with artificial intelligence problems and their formulations.
BCS-100A.3 understand Intelligent system, Agents & its environment.
BCS-100A.4 understand applications of artificial intelligence.

Unit-1: AI Introduction, Background and History
1.1 Introduction to AI
1.2 Foundations of AI
1.3 AI Evolution
1.4 Introduction to AI programming languages

Unit-2: AI Problem Formulation
2.1 AI problem formulation
2.2 Problem characteristics
2.3 Production System
2.4 Production System characteristics

Unit 3: Intelligent System & Agents
3.1 Introduction to intelligence system
3.2 Types of Intelligence
3.3 Difference between Human and Machine learning
3.4 Introduction to Agent & environment
3.5 Structure of Intelligent Agent
3.6 Nature and Properties of Environment.

Unit-4: AI Applications
4.1 Robotics
4.2 Natural Language Processing
4.3 Computer Vision
4.4 Health Care
4.5 Education
4.6 Expert System

Text Books / Reference Books:

1. Elain Rich and Kevin Knight (2009), Artificial Intelligence, 3rd edition, Tata McGraw Hill.
2. Stuart J.Russel and Peter Norvig (2009), Artificial Intelligence-A modern approach: 3rd edition, Pearson.
3. Patrick Henry Winston (1992), Artificial Intelligence , 3rdedition, , Pearson.
4. George F Luger, (2009), Artificial Intelligence : Structures and Strategies for Complex Problem Solving , University of New Mexico,6th edition, Pearson.
5. V S Janakiraman, Parerback (2005), Foundations of Artificial Intelligence And Expert Systems : 3rd edition, Macmillan India Limited

Software required/Weblinks:
http://artint.info/html/ArtInt_351.html
http://www.tutorialspoint.com/artificial_intelligence/
http://www.compinfo-center.com/tpai-t.htm

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%

Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-100A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-100A.1	2	2	1	2									2	2	3
BCS-100A.2	2	3	2	3									2	2	3
BCS-100A.3	3	2	2	2									3	3	3
BCS-100A.4	3	3	2	3									2	3	3

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BME-101A: ENGINEERING GRAPHICS & DESIGN

Periods/week Credits — Max. Marks : 200
L: 0 T: 0 P: 4 2 — Internal/Continuous Assessment : 100
Duration of Examination: 3 Hrs — End Semester Exam : 100

Prerequisites: NIL
Course Type: Engineering Science Course
Course Coordinator / Co-Coordinator:

Course Outcomes: After completion of this course the students will be able to

BME-101A.1	understand the role and importance of Engineering Graphics, design/drafting in cognitive development.
BME-101A.2	conceptualize engineering drawing and descriptive geometry to understand different components and machineries.
BME-101A.3	visualize objects with the help of engineering principles, projection theories including their applications to solve problems related to engineering and production.
BME-101A.4	develop capability of understanding engineering drawing problems and implementation of respective solution.
BME-101A.5	develop capability of selection of solutions for a given design problem.
BME-101A.6	develop of capability of designing a product or assembly with its various components with a systematic design approach

Theory (Detailed Content)

Traditional Engineering Graphics:
Principles o f Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.
(**Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory**)

Part-A

Unit 1: Introduction to Engineering Drawing, Orthographic Projections
Principles of Engineering Graphics and their significance, usage of drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales; Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Unit 2: Projections of Regular Solids & Sections and Sectional Views of Right Angular Solids
Inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).

Unit 3: Isometric Projections
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric
Views to Orthographic Views and Vice-versa, Conventions;

Theory (Detailed Content)
Computer Graphics
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(**Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory**)

Part-B

Unit 4: Overview of Computer Graphics, Customization & CAD Drawing
Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids; consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Unit 5: Annotations, layering, other functions
Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing

sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

Unit 6: Demonstration of a simple team design project

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying color coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. (Corresponding set of) CAD Software Theory and User Manuals

Reference Books:

1. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
2. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

Weblinks:

https://nptel.ac.in/courses/112103019/
https://nptel.ac.in/courses/112104172/

Assessment Tools:

Surprise questions during lab/Class Performance
Term end examination/viva

Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BME-101A.1	2	1	1	1	1	2	1	2	1	1	2	3	3	3	2
BME-101A.2	2	2	3	1	1	2	2	2	2	2	3	2	3	2	2
BME-101A.3	2	2	2	2	2	1	2	1	3	2	2	2	3	2	1
BME-101A.4	3	3	2	3	2	1	2	2	1	1	2	1	3	2	2
BME-101A.5	3	3	2	3	2	1	2	1	1	1	2	1	3	2	2
BME-101A.6	2	1	3	2	3	2	2	2	3	2	2	1	3	2	2

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BPH-151A: PHYSICS LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Internal	: 50
Duration of Examination: 2 Hrs		External	: 50

Pre-requisite: Basic knowledge of 10+2 level Physics
Course Type: Basic Sciences Courses

Course Outcomes: The students will be able to:
BPH-151A.1 calculate zero error, least count, maximum percentage error, percentage error and understand their importance
BPH-151A.2 understand the principle, concept and working of the experiments
BPH-151A.3 rearrange/assemble the different components of a device or a circuit
BPH-151A.4 describe the methodology of science and the relationship between observation and theory

List of Experiments:

1. To calculate the hysteresis loss and magnetic susceptibility by tracingB- H curve.
2. To determine the value of Planck’s constant h by a photo cell.
3. To determine the grating element of a given grating by using LASER.
4. To study Hall Effect in a semiconductor and to find (i) Hall voltage and Hall coefficient (ii) number of charge carriers per unit volume (iii) mobility.
5. To draw the characteristics of a solar cell and to find the fill factor.

6. To find the band gap of an intrinsic semiconductor using four probe method.
7. To draw the V-I characteristics of a PIN diode.
8. To determine numerical aperture of an optical fibre.
9. To determine the volume magnetic susceptibility of manganese sulphate solution at different concentrations.
10. To find the charge to mass (e/m) ratio of an electron.
11. To study the resonance phenomena in LCR circuits.
12. To study the variation of magnetic field from Helmholtz coil.
13. To determine the moment of inertia of a flywheel.
14. To determine the Young's modulus of the material of a given beam supported on two knife-edges and loaded at the middle point.
15. To determine the Modulus of Rigidity of a wire by Maxwell's Needle.

Text Books/References:

1. S. L. Gupta & V. Kumar, Practical Physics, 2018, Pragati Prakashan.
2. S.L. Arora, B.SC, Practical Physics, 2010, S. Chand.
3. NPTEL video lectures for Experimental Physics.

Instructions for Exam: One experiment out of 10 given randomly needs to be performed in exams.

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BPH-151A.1	3	1		1				1	1	1		3	2	1	
BPH-151A.2	2		2		2				1	1		2	1	1	
BPH-151A.3	2	3	2	3	3				3		1	3	2		2
BPH-151A.4	3	1	2		1		1	1	1	1		3	1	1	

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BEE-151A: BASIC ELECTRICAL ENGINEERING LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Internal/Continuous Evaluation:	50
Duration of Examination: 2 Hours		End Semester Exam	: 50

Pre-requisite: Basic knowledge of 10+2 level Physics
Course Type: Engineering Sciences Courses

Course Outcomes: The students will be able to
BEE-151A.1 familiarize with the measuring instruments, breadboard, CRO, components of LT installation
BEE-151A.2 understand the transformers connection both single and three phase.
BEE-151A.3 study the working principles of electric machines and power converters
BEE-151A.4 design a simple PCB with software.

LIST OF EXPERIMENTS:
1. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors and verification of basic laws.
2. To measure the steady-state and transient time-response of R-L/R-L circuits to a step change in voltage (transient may be observed on a storage oscilloscope).
3. To examine sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage.
4. To find the resonance frequency inR-L-C circuits..
5. To observe the no-load current waveform of transformer on an oscilloscope (non- sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).
6. To perform Load test on a transformer: measurement of primary and secondary voltages and currents, and power.
7. To connect Three-phase transformers in Star and Delta and verify voltage and current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side and to measure three-phase power in balanced three-phase circuits.
8. Identification of various types of Printed Circuit Boards (PCB) and soldering techniques.
9. Introduction to PCB design software.
10. PCB Lab a) Artwork & printing of simple PCB b) Etching & drilling of PCB.

11. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine.
12. To draw Torque -Speed Characteristic of dc motor.
13. To find Synchronous speed of two and four-pole three-phase induction motors, check Direction reversal by change of phase-sequence of connections and to draw Torque-Slip Characteristic of an induction motor.
14. To Study components of LT, switchgear- MCB, ELCB, MCCB.
15. To Study DC-DC Converter.

Text Books:
Dr. N K Jain ,2010, A text book of Practicals in Electrical Engineering, Dhanpatrai Publishing Co.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

COURSE ARTICULATION MATRIX

CO Statement (BEE-151A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BEE-151A.1	3	3	2	1	1	-	-	-	-	-	-	2	3	1	1
BEE-151A.2	3	3	3	1	1	-	-	-	-	-	-	2	3	1	1
BEE-151A.3	3	3	3	1	1	-	-	-	-	-	-	2	3	3	1
BEE-151A.4	3	3	3	1	1	-	-	-	-	-	-	2	3	1	1

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CDC-PC-101: Professional Communication - I

Periods/week	Credits	Max. Marks : 100
L: 2 T: 0	2	Continuous Evaluation: 50
Duration of Examination: 1.5 Hrs		End Semester Examination: 50

Student Outcomes

CDC-PC-101.1: Students will be able to develop all-round personality by mastering interpersonal skills to function effectively in different circumstances.

CDC-PC-101.2: Students will be able to demonstrate effective communication through grammatically correct language.

CDC-PC-101.3: Students will be able to apply effective listening and speaking skills in real life scenarios.

Unit 1: **Attitudinal Communication**

1.1 Attitude and its Impact on Communication

1.2 Courtesy & Politeness in Communication

1.3 Diversity & Inclusion – Bullying, Cultural Sensitivity, Stereotypes, Sexual Harassment, LGBTQ, Respect, Chivalry, Racial & Gender Discrimination, Disability Harassment, Inclusion.

1.4 Power Dressing

Unit 2**: Syntactical Communication - I**

2.1 Common errors in communication

2.2 Identification of word class

2.3 Errors & rectifications in

2.3.1 Article usage

2.3.2.Tenses usage - Present Perfect vs. Past Simple vs. Past Perfect

2.3.2 Subject Verb Agreement

Unit 3**: Phonetics**

3.1 Impact of First Language Influence

3.2 Tone

3.3 Intonation

3.4 Rate of Speech

3.5 Pronunciation: Vowels & Consonant sounds

Unit 4**: Developing Communication Skills -I (Listening & Speaking)**

4.1 Concept of LSRW: Importance of LSRW in communication.

4.2 Listening Skills : Real Life challenges, Barriers to Listening

4.3 Speaking : Self Introduction, Interview, GD, Resume

Continuous Evaluation Distribution:-

Sessional (Average of Sessional I & Sessional II)	30 marks
Assignment	10 marks

Class performance	5 marks
Attendance	5 marks

Course Articulation Matrix

CO Statement (CDC PC101)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**O10**	**O11**	**O12**	**PSO 1**	**PSO 2**	**PSO 3**
CDC-PC-101.1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CDC-PC-101.2	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-
CDC-PC-101.3	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-

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BHM-MC-001: CONSTITUTION OF INDIA

Periods/week Credits	Max. Marks	: 100
L :0 T: 1 AP	Continuous Evaluation: 50	
Duration of Exam: 2 Hrs	End Semester Exam	: 50

Pre-Requisite: Nil
Course Type: HSMC

Unit-1: Background:
India's struggle for independence, Formation of the Constituent Assembly, The Union and its Territory : Nomenclature, Formation of New States and Alteration of Areas, Citizenship : Citizenship at the Commencement of the Constitution, Rights of Citizenship of certain persons, Rights of Citizenship of certain persons of Indian origin residing outside India, Continuance of the rights of Citizenship, Parliament to regulate the right of the Citizenship by law.

Unit-2: Fundamental Rights and Directive Principles :
Definition, Laws inconsistent with or in derogation of the Fundamental Rights, Equality before law, Prohibition of discrimination on grounds of religion, race, caste, sex or place of birth, Equality of opportunity in matters of public employment, Abolition of untouchability, Abolition of Titles- Right to Freedom, Right against Exploitation, Right to freedom of religion, Cultural and Educational rights, Right to constitutional remedies, Directive principles of State Policy : Definition, Right to work, Right to education and to public assistance in certain cases, provisions for just and humane condition of work and maternity relief, uniform civil code for the citizens, protection and improvement of environment and safeguarding of forests and wildlife, protection of monuments and places and objects of national importance, separation of judiciary from executive, promotion of international peace and security and Fundamental Duties.

Unit-3: The Union:
The executive, The President and Vice President of India, Council of Ministers, Attorney General for India, Parliament, Legislative procedure, The Union Judiciary: Establishment and constitution of Supreme Court, Powers and Functions of Supreme Court, Original Jurisdiction of the Supreme Court, The States : Definition, The Governor, Council of Ministers, The Advocate General for the State, The State Legislature, Legislative Procedure, High Courts in the State, The Union Territories, The Panchayats, Municipalities, Relations between the Union and the States.

Unit-4:Services under the Union and the States:
Services, Public Service Commissions, Elections: Election Commission of India, Emergency Provisions : Proclamation of Emergency, Amendment of the Constitution, Temporary, Transitional and Special Provisions, Schedules : First to Tenth Schedule and Miscellaneous.

Text books/reference books:

1. R. Bhargava, (2008) 'Introduction: Outline of a Political Theory of the Indian Constitution', in R. Bhargava (ed.) Politics and Ethics of the Indian Constitution, New Delhi: Oxford University Press, pp. 1-40.
2. G. Austin, (2000) 'The Social Revolution and the First Amendment', in Working a Democratic Constitution, New Delhi: Oxford University Press, pp. 69-98.
3. A. Sibal, (2010) 'From Niti to Nyaya,' Seminar, Issue 615, pp 28-34.
4. B. Shankar and V. Rodrigues, (2011) 'The Changing Conception of Representation: Issues, Concerns and Institutions', in The Indian Parliament: A Democracy at Work, New Delhi: Oxford University Press, pp. 105-173.
5. V. Hewitt and S. Rai, (2010) 'Parliament', in P. Mehta and N. Jayal (eds.) The Oxford Companion to Politics in India, New Delhi: Oxford University Press, pp. 28-42.
6. J. Manor, (2005) 'The Presidency', in D. Kapur and P. Mehta P. (eds.) Public Institutions in India, New Delhi: Oxford University Press, pp.105-127.
7. J. Manor, (1994) 'The Prime Minister and the President', in B. Dua and J. Manor (eds.) Nehru to the Nineties: The Changing Office of the Prime Minister in India, Vancouver: University of British Columbia Press, pp. 20-47.
8. U. Baxi, (2010) 'The Judiciary as a Resource for Indian Democracy', Seminar, Issue 615, pp. 61-67.
   R. Ramachandran, (2006) 'The Supreme Court and the Basic Structure Doctrine' in B. Kirpal et.al (eds.) Supreme but not Infallible: Essays in Honour of the Supreme Court of India, New Delhi: Oxford University Press, pp. 107-133.

9. M. Singh, and R. Saxena (eds.), (2011) ‘Towards Greater Federalization,’ in Indian Politics: Constitutional Foundations and Institutional Functioning, Delhi: PHI Learning Private Ltd., pp. 166-195.
10. V. Marwah, (1995) ‘Use and Abuse of Emergency Powers: The Indian Experience’, in B. Arora and D. Verney (eds.) Multiple Identities in a Single State: Indian Federalism in a Comparative Perspective, Delhi: Konark, pp. 136-159.
11. B. Sharma, (2010) ‘The 1990s: Great Expectations’; ‘The 2000s: Disillusionment Unfathomable’, in Unbroken History of Broken Promises: Indian State and Tribal People, Delhi: Freedom Press and Sahyog Pustak Kuteer, pp. 64-91.
12. P. deSouza, (2002) ‘Decentralization and Local Government: The Second Wind of Democracy in India’, in Z. Hasan, E. Sridharan and R. Sudarshan (eds.) India’s Living Constitution: Ideas, Practices and Controversies, New Delhi: Permanent Black, pp. 370-404.
13. M. John, (2007) ‘Women in Power? Gender, Caste and Politics of Local Urban Governance’, in Economic and Political Weekly, Vol. 42(39), pp. 3986-3993

Distribution of Continuous evaluation table

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

SEMESTER – II

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BCH-106: CHEMISTRY FOR ENGINEERS

Periods/week Credits	Max. Marks	: 200
L: 2 T: 0 2	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs	End Term Examination	: 100

Pre-requisite: Basic knowledge of 10+2 level Chemistry
Course Type: Basic Sciences

Course Outcomes: The course will enable the student to-
BCH-106.1. Apply fundamental principles to predict the structure, stereochemistry, bonding and general properties of materials.
BCH-106.2.Predict potential applications and practical utility of chemistry in different areas and propose suitable analytical techniques for practical applications.
BCH-106.3. Develop the understanding of water treatment techniques, electrochemical cells and combustion technology.

Unit 1: Water Treatment Chemistry (5 Lectures)
Impurities in water, Drinking Water quality standards, Hardness, types and its determination by EDTA method, Alkalinity and its determination, numerical problems based on hardness & alkalinity, Water softening methods: zeolite, ion-exchange process, Desalination of water: Reverse osmosis (RO) & Electro-dialysis process

Unit 2: Electrochemical cells and Fuels (5 Lectures)
Basic concepts of cells, Primary cells, Secondary cells and batteries, Fuel cells, Fuels and their types, Combustion technology

Unit 3: Phase Rule and its applications (4 Lectures)
3.1 Terminology of Gibb's phase rule and problems based on phase rule equation, One component system (water), Two component Eutectic system (Pb-Ag), Industrial applications of phase diagrams

Unit 4: Atomic and molecular structure (5 Lectures)
Limitations of classical mechanics in treating atomic and molecular phenomena, Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and nanoparticles, Molecular orbital treatment for homo-nuclear diatomic molecules, Bonding in Coordination Compounds: Crystal field theory

Unit-5: Stereochemistry (4 Lectures)
Structural isomers and stereoisomers, Representations of 3 dimensional structures, Enantiomers, diastereomers, Absolute configurations and conformational analysis

Unit6: Analytical Techniques(5 Lectures)
Basic Principles of spectroscopy, UV- VIS spectroscopy and its applications, IR spectroscopy and its applications, Principle and analytical applications of Atomic Absorption spectroscopy, brief overview of Inductively coupled plasma mass spectrometry

Text Books/ Reference books/Web references:

1. P. C. Jain and Monica Jain, Engineering Chemistry, 2017, Dhanpat Rai Publishing Company.
2. Prasanta Rath, Subhendu Chakroborty, Chemistry, 2018, Cengage Learning Publishers.
3. B. H. Mahan,2010, University Chemistry, Pearson Education.
4. C. N. Banwell, 2008, Fundamentals of Molecular Spectroscopy, McGraw Hill Education India.
5. Gourkrishna Dasmohapatra, 2019, Chemistry-I, Vikas Publishing.
6. https://nptel.ac.in/courses/103/108/103108138/
7. https://nptel.ac.in/courses/122/101/122101001/

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Assignments, Sessional and End Semester Examination paper will consist of various difficulty levels to accommodate the different capabilities of students. Assessment should cover all course outcomes and upper limit for lower order skills will be 40% (for knowledge-oriented questions). However, weightage for different cognitive levels in the question papers can vary.

Instructions for paper setting: The paper setter must ensure the coverage of entire syllabus while setting the question papers and mention the learning outcomes across each section to be measured by the examination. Weightage of the sections may vary as per the number of respective lecture hours mentioned in the syllabus.Action verbs should be used from Bloom's Taxonomy while designing question papers.

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O2	PS O3
BCH-106.1	3	3	1	-	1	-	-	-	-	-	-	2	1	-	-
BCH-106.2	3	3	2	-	2	2	2	-	-	-	-	2	-	1	-
BCH-106.3	3	3	2	-	2	2	2	-	-	-	-	2	1	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

NAAC 'A++' Grade University

BMA-201: Mathematics- II (Probability and Statistics)

Periods/week	Credits	Max. Marks	: 200
L: 3 T: 1	4	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs		End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of basic concepts of probability of Intermediate level.
Course Type: Basic Sciences

Course Outcomes: Students will be able to-

BMA-201.1. Understand the role of mathematics in in the digital society.

BMA-201.2. Define the concepts of probability and random variables and various discrete and continuous probability distributions and their properties.

BMA-201.3. Demonstrate the knowledge of measures of central tendency, correlation and regression.

BMA-201.4. Explain the types of probability distributions with formulas or plotted through graphs for easy interpretation of the data.

BMA-201.5. Construct and examine the samples.

BMA-201.6. Apply statistical methods for studying data samples.

PART-A

Unit 1: Basic Probability

Probability spaces, conditional probability, independence, Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Unit 2: Continuous Probability Distributions

Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Unit 3: Bivariate Distributions

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

PART-B

Unit 4: Basic Statistics

Measures of Central tendency: Moments, skewness and Kurtosis, Probability distributions: Binomial, Poisson and Normal, evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Unit 5: Applied Statistics

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Unit 6: Small Samples

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Text Books/Reference Books

1. Erwin Kreyszig, 2006, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
2. P. G. Hoel, S. C. Port and C. J. Stone, 2003 (Reprint), Introduction to Probability Theory, Universal Book Stall.
3. S. Ross, 2002, A First Course in Probability, 6th Ed., Pearson Education India.
4. W. Feller, 1968, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley.
5. N.P. Bali and Manish Goyal, Reprint 2010, A text book of Engineering Mathematics, Laxmi Publications.
6. B.S. Grewal, 2000, Higher Engineering Mathematics, Khanna Publishers, 35th Edition.
7. Veerarajan T., 2010, Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B(one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement (BMA-201)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BMA-201.1	3	3	1	2	2	--	--	--	--	--	--	2	--	--	--
BMA-201.2	3	3	1	2	2	--	--	--	--	--	--	1	--	--	--
BMA-201.3	3	3	2	2	3	--	--	--	--	--	--	2	--	--	--
BMA-201.4	3	2	1	1	2	--	--	--	--	--	--	1	--	--	--
BMA-201.5	3	3	2	2	3	--	--	--	--	--	--	2	--	--	--
BMA-201.6	3	3	2	2	2	--	--	--	--	--	--	2	--	--	--

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A++' Grade University

BCS-101A: PROGRAMMING FOR PROBLEM SOLVING

Periods/week Credits | Max. Marks : 200
L :3 T: 0 3.0 | Continuous Evaluation : 100
Duration of Exam: 3 Hrs | End Term Examination : 100

Pre-Requisite: Basic Knowledge of Computers
Course Type: Engineering Science Course

Course Outcomes: The students will be able to-

BCS-101.1. Formulate simple algorithms for arithmetic and logical problems with correct logic.
BCS-101.2. Implement the conditional statement and ietration with understanding of concepts.
BCS-101.3. Decompose a problem into functions and able to understand use of functions.
BCS-101.4. Apply advance C programming techniques such as arrays, pointers, dynamic memory allocation, structures to develop solutions for particular problems.

PART- A

Unit-1: Introduction to Programming

1.1. Introduction to programming
1.2. Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)
1.3. Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/ Pseudo code with examples.
1.4. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.
1.5. Expressions, Precedence and Associatively, Expression Evaluation, Type conversions

Unit-2: Loops and Conditional Statements

2.1 Arithmetic expressions and precedence
2.2 Conditional Branching; Writing and evaluation of conditionals and consequent branching
2.3 Iteration and loops

Unit-3: Arrays and Structures

3.1 Arrays (1-D, 2-D):1 D array and function–Passing individual array elements to a function, passing individual array elements address to a function, passing whole 1d array to a function, 2D array and function, Passing individual array elements to a function, passing individual array elements address to a function, passing whole 2d array to a function
3.2 Character Arrays and Strings
3.3 Structures; Defining Structures
3.4 Array of Structures

PART –B

Unit-4: Functions

4.1 Functions (including using built in libraries)
4.2 Parameter passing in functions
4.3 call by value.
4.4 Passing arrays to functions: idea of call by reference
4.5 Recursion, as a different way of solving problems.
4.6 Example programs, such as Finding Factorial, Fibonacci series.

Unit-5: Basic Algorithms

5.1 Iterative Searching (Linear and Binary Search)
5.2 Basic Sorting Algorithms with implementation (Bubble, Insertion and Selection)
5.3 Finding roots of equations
5.4 Notion of order of complexity through example programs (no formal definition required)

Unit-6: Pointers and File Handling

6.1 Idea of pointers, Defining pointers,Pointer to an array,Array of pointers,Pointers and two dimensional arrays

6.2 Use of Pointers in self-referential structures
6.3 Notion of linked list (no implementation)
6.4 File Handling :Working with text files and Binary Files,File operations using std. library and system calls–File management I/O functions

Text Books / Reference Books:

1. Byron Gottfried, 2015, Schaum's Outline of Programming with C: 2nd Ed., McGraw-Hill.
2. E. Balaguruswamy, 1998, Programming in ANSI C: 2nd Ed., Tata McGraw-Hill.
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language:, 2nd Ed., PHI.

Software required/Weblinks:
Turbo C
www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-101A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-101A.1	2	3	2	-	2	-	-	-	-	-	-	3	1	1	-
BCS-101A.2	2	1	2	1	3	-	-	-	-	-	-	-	-	1	1
BCS-101A.3	-	1	2	-	1	2	-	-	-	-	-	1	3	2	1
BCS-101A.4	3	3	1	3	2	-	-	-	-	-	-	-	3	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BBT-100A: BIOLOGY FOR ENGINEERS

Periods/week Credits	Max. Marks: 200
L: 2T: 0P:0 02	Continuous Evaluation : 100
Duration of Examination: 3 Hrs	End Semester Examination:100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Basic Sciences

Course Outcomes:
The students will be able to-

BBT-100A.1 Describe the taxonomic diversity of life forms and their functions.
BBT-100A.2 Assess the role of biomolecules in physiology and their applications for humankind.
BBT-100A.3 Illustrate the structural and functional organization of the human body.
BBT-100A.4 Apply the principles of biology and genetics for sustenance.

PART-A

Unit 1: The Living World
1.1 Origin of Life
1.2 Structural Organization of life forms
1.3 Microbes in daily life
1.4 Cell- The unit of Life
1.5 Human Evolution

Unit 2: Biomolecules and Applications
2.1 Carbohydrates, Proteins, Lipids (Types and roles)
2.2 Nucleic acids and their types
2.3 Enzymes and mechanism of action
2.4 Applications of biomolecules (Bioplastics, Vaccines, Alternative Proteins, Biodiesel, Biosensors)
2.5 Bioengineering (Bioprinting, Bioimaging, Bioremediation, Biomimics)

PART-B

Unit 3: Human Organ Systems and Biodesign
3.1 Brain as CPU
3.2 Heart as Pump System
3.3 Lungs as Purification System
3.4 Kidney as Filtration system
3.5 Muscular and skeletal systems as scaffolds

Unit 4: Science of Genome
4.1 DNA Replication and Central Dogma
4.2 DNA Sequencing and Applications
4.3 Mutations and Genetic Disorders
4.4 Computational Approach to Biology-Making sense of the Big Data, Types of Biological Dataset, Role of AI in Healthcare

Text/ Reference Books:
1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wileyand Sons
3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freemanand Company
4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering the entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Students need to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-100A.1	1	-	1	-	-	1	1	-	-	-	3	1	1	2	1	-
BBT-100A.2	2	2	1	2	2	2	2	-	-	-	3	3	3	3	2	-
BBT-100A.3	3	3	2	2	2	3	1	-	-	-	2	3	3	3	2	-
BBT-100A.4	3	3	3	2	2	3	3	-	-	1	3	3	3	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

NAAC 'A++' Grade University

BME-102: WORKSHOP/MANUFACTURING PRACTICES

Periods/weekCredits	Max. Marks :200
L: 0 T: 0P:4 2	Continuous Assessment :100
Duration of Examination:3Hrs	End Semester Exam :100

Prerequisites: basic knowledge of Science and Mathematics Course
Type: Engineering Science Course

Course Outcomes:
After completion of this course the students will be able to

BME-102.1	Learn the basic manufacturing/fabrication processes and develop skills to fabricate with their own hand.
BME-102.2	Understand how to operate various traditional and modern machine tools used inindustries.
BME-102.3	Apply knowledge of the dimensional accuracies and dimensional tolerances, basics of various measuring instruments, hand tools and cuttingtools.
BME-102.4	Acquire knowledge of safetymeasurements
BME-102.5	Understand the impact of manufacturing engineering solution.
BME-102.6	Assemble different mechanicalcomponent/parts

Lectures & Videos (10 Hrs)

(i) Detailed Content

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3lectures).
2. CNC machining, Additive manufacturing (1lecture)
3. Fitting operations & power tools (1lecture)
4. Electrical &Electronics (1lecture)
5. Carpentry (1lecture)
6. Plastic moulding, glass cutting (1lecture)
7. Metal casting (1lecture)
8. Welding (arc welding & gas welding), brazing (1lecture)

(ii) Workshop Practice: (60hours)

1. Machine shop (10hours)
2. Fitting shop (8hours)
3. Carpentry (6 hours)
4. Electrical & Electronics (8 hours)
5. Welding shop (8 hours) (Arc welding 4 hrs + gas welding 4hrs)
6. Casting (8hours)
7. Smithy (6hours)
8. Plastic moulding & Glass Cutting (6hours)

Students Project Fabrication

Students have to fabricate product from the assigned list with their own hands. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different workshop processes. The final product should be assembly of different components fabricated by different workshop practices.

For e.g. Tack-hammer; Project Display Stand; Pen stand, Screw Driver, Variable size Spanner, Electrical Extension Board with electronic circuits or any other product which should involve multiple workshop practices to fabricate a single product.

Each student will be issued the drawings of the product assembly along with the drawing of the sub-part assembly, mentioning the dimensions, tolerance, sub-products used.

Students should follow the process planning sheet of the product and get involved in different workshop practices to complete the jobs for final submission.

Note: Each student should do more than one product to get hands on experience of all the workshop practices.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited,Mumbai.

2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition,2002.
3. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.

Reference Books:

1. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998.
2. Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGrawHill House, 2017.

Weblinks:

https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-me21/

Instructions for setting of Paper Seven questions are to set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each part A and part B (one from each unit). Student needs to attempt two questions out of three questions from each part. Each question will be of 20 marks.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BME-102.1	3	3	3	3	2	1	1	2	2	2	2	3	3	3	3	3
BME-102.2	3	3	3	3	3	2	1	2	2	2	2	2	2	2	2	2
BME-102.3	3	3	3	3	3	2	2	1	2	2	1	2	2	2	2	2
BME-102.4	2	2	2	2	3	2	1	1	2	1	2	2	3	2	2	2
BME-102.5	3	2	2	2	2	3	3	2	2	2	2	2	3	2	2	2
BME-102.6	3	3	3	2	2	1	2	2	2	3	2	2	2	2	2	2

NAAC 'A++' Grade University

BCH-151A: CHEMISTRY LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Term Examination	: 50

Pre-requisite: Basic knowledge of 10+2 level Chemistry
Course Type: Basic Sciences Courses

Course Outcomes: The students will be able to:
BCH-151A.1. analyze the need and utility of the experiments.
BCH-151A.2. precise quantitative measurements using volumetric glassware, analytical balance, and prepare standards solutions independently.
BCH-151A.3. carry out experiments to check the hardness, alkalinity and chloride content of different water samples and interpret the results.
BCH-151A.4. employ the basic methods/techniques to measure surface tension, viscosity, conductance, emf, saponification value of different samples.

List of Experiments:

1. Preparation and standardization of volumetric solutions.
2. Determination of viscosity using Ostwald Viscometer.
3. Determination of hardness of water by EDTA method.
4. Determination of alkalinity of water.
5. Determination of strength of solution by Conductometric titration.
6. Determination of Ferrous ion concentration using Potentiometer.
7. Determine the percentage composition of given mixture of sodium hydroxide and sodium chloride.
8. Determination of viscosity of lubricating oils using Redwood viscometers.
9. Determination of chloride content of water.
10. Determination of surface tension using Stalagmometer.
11. Determination of saponification value of oils.
12. Determination of the partition coefficient of a substance between two immiscible liquids.

Text Books/ Reference books/Web references:

1, Sunita Rattan, 2011, **Experiments in Applied Chemistry**, S.K.Kataria & sons.
2. Shailendra K.Sinha,2014, Physical Chemistry A Laboratory Manual, Alpha Science International Limited.
3. https://vlab.amrita.edu/index.php?sub=2&brch=190
4.https://vlab.amrita.edu/index.php?sub=2&brch=193&sim=575&cnt=1

Instructions for Exam: One experiment out of 10 given randomly needs to be performed in exams.
Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance

Viva (Question and answers in lab)
End Term Practical Exam

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
BCH-151A.1	3	3	2	1	1	-	1	1	1	1	-	2	-	-	-
BCH-151A.2	3	3	2	1	2	-	1	1	1	1	-	2	-	-	-
BCH-151A.3	3	3	2	1	2	-	2	1	1	1	-	2	-	-	-
BCH-151A.4	3	3	2	1	1	-	1	1	1	1	-	2	-	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BCS-151A: PROGRAMMING FOR PROBLEM SOLVING LAB

Periods/week	Credits	Max. Marks :100
P :2	1.0	Continuous Evaluation : 50
Duration of Exam: 2 Hrs		End Term Examination : 50

Co-Requisite: Programming for problem solving (BCS-101A)
Course Type: Engineering Science Course

Course Outcomes: Students will be able to-

BCS-151A.1.	Formulate the algorithms for simple problems in C language.
BCS-151A.2.	Understanding of syntax errors as reported by the compilers as well as logical errors.
BCS-151A.3.	Write iterative as well as recursive programs,implementing of arrays, strings and structures and various graph traversing algorithms.
BCS-151A.4.	Declare pointers of different types and able to understand the concept of file handling.

NOTE: The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.

List of Practicals:
Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value,call by refrence
Lab 7: Simple functions
Tutorial 8: Recursion, structure of recursive calls
Lab 8: Recursive functions
Tutorial 9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 9: Programming for solving Numerical methods problems
Tutorial 10: Pointers, structures and dynamic memory allocation
Create a menu for student attendance monitoring system.
Lab 10: Pointers and structures
Tutorial 11: File handling
Lab 11: File operations
Create a database for an organization having the details of employees

Software required/Weblinks:
Turbo C
www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

COURSE ARTICULATION MATRIX :

CO Statement (BCS-151A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-151A.1	2	1	2	2	-	-	-	-	-	-	2	1	2	-	1
BCS-151A.2	3	-	-	3	2	-	-	-	-	-	-	-	2	3	3
BCS-151A.3	3	1	2	3	-	1	-	-	-	-	-	-	1	2	-
BCS-151A.4	2	3	1	2	3	-	-	-	-	-	1	1	3	2	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BCH-MC-002: EVS

Periods/week	Credits	Max. Marks	: 100
L: 0 T: 1 P: 0	AP	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Sem Examination	: 50

Pre-requisites: Basic knowledge of Environment related issues
Course Type: HSMC

Course Outcomes : Students will be able to-
BCH-MC-002.1: Comprehend various environmental issues through various activities.
BCH-MC-002.2: Understand that each and every action of ours reflects on the environment and collaborate in groups to suggest innovative ways to protect environment through project work/report writing.

Idea of an activity based course on environment protection is to sensitize the students on environment related issues through various activities. Students must understand that each and every action of ours reflects on the environment and vice versa.

Activities:
i) Small group meetings about conservation and management of natural resources, conservation of biodiversity, solid waste management and environmental remediation
ii) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
iii) Expert talk
iv) Slogan writing /Poster making event
v) Cycle rally to create awareness on issues like pollution control, cleanliness, and waste management.
vi) Plantation activity
vii) Cleanliness drive
viii) Drive for segregation of waste
ix) Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
x) Environment protection related efforts

Distribution of marks:
Continuous Evaluation Marks
Evaluation based on participation in activities: 50 marks
End Sem Examination Marks
Field work, Report writing & Viva: 20+20+10 = 50 marks

Course Articulation Matrix

CO Statement (BCH-MC-002)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCH-MC-002.1	1	2	1	-	-	2	3	2	1	-	-	1	-	-	-
BCH-MC-002.2	1	2	1	-	-	2	3	2	1	-	-	1	-	-	-

MANAV RACHNA INTERNATIONAL INSTITUTES OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of UGC Act 1956)
NAAC 'A++' Grade University
CDC-PC-102: Professional Communication - II

Periods/week	Credits	Max. Marks : 100
L: 2 T: 0	2	Continuous Evaluation: 50
Duration of Examination: 1.5 Hrs		End Semester Examination: 50

Student Outcomes: Students will be able to

CDC-PC-102.1: exhibit effective reading and writing skills in a professionally stimulated environment.
CDC-PC-102.2: enhance skills to effectively deliver formal and informal presentations to a variety of audiences in multiple contexts.
CDC-PC-102.3: learn grammatically correct formal writing skills.

Unit 1: **Developing Communication Skills- II (Reading & Writing)**
1.1 Reading Comprehension
1.2 Writing Skills: Specific to AMCAT. Introduction to Writing: Organizing Principles of Paragraph, Precise Writing, Punctuations
1.3 Report Writing
1.4 Note Taking

Unit 2**: Syntactical English II**
2.1 Indianism & Localism
2.2 Conditionals
2.3 Preposition of Time & Place

Unit 3**: Effective Communication**
3.1 Concepts of Chronemics: Interpretation of time with business environment
3.2 Monochromic vs. Polychromic Cultures
3.3 Non- Verbal Communication: Kinesics & Proxemics
3.4 Acing virtual (video) interviews

Unit 4**: Presentation Skills**
4.1 Opening & closing of Presentations
4.2 Audience Analysis
4.3 Structuring the Presentation
4.4 Best Practice in Presentations

Continuous Evaluation Distribution:-

Sessional (Average of Sessional I & Sessional II)	30 marks
Assignment	10 marks
Class performance	5 marks
Attendance	5 marks

Course Articulation Matrix

CO Statement (CDC-PC-102)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**O10**	**O11**	**O12**	**PSO 1**	**PSO 2**	**PSO 3**

CDC-PC-102 .1	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-
CDC-PC-102 .2	-	-	-	-	-	-	-	-	-	3	-	1	-	-	-
CDC-PC-102 .3	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-

SEMESTER – III

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-301 : DATA STRUCTURES & ALGORITHMS

Periods/week	Credits	Max. Marks	: 200
L :3 T: 1	4.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Core

Course Outcomes: The students will be able to-

BCS-DS-301.1	Define the concepts of data structures, searching, sorting and their complexity
BCS-DS-301.2	Understand the structured data types and their applications
BCS-DS-301.3	Apply the data structures to real life problems of sorting, searching, traversal
BCS-DS-301.4	Analyze the complexity of different data structures operations, sorting and searching
BCS-DS-301.5	Evaluate the different sorting algorithms in best, average and worst case scenarios
BCS-DS-301.6	Design the best solution for real life problems using various data structures

PART-A

Unit 1: Introduction
1.1 Basic Terminologies: Elementary Data Organizations, Data Structures
1.2 Operations: insertion, deletion, traversal
1.3 Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off
1.4 Searching: Linear Search and its complexity analysis
1.5 Binary Search Techniques and its complexity analysis

Unit 2: **Linked Lists**
2.1 Singly linked lists: Representation in memory
2.2 Algorithms of several operations: Traversing, Searching
2.3 Insertion into, Deletion from linked list
2.4 Doubly linked list: operations on it and algorithmic analysis
2.5 Circular Linked Lists: all operations their algorithms and the complexity analysis
2.6 Header linked List and Header nodes

Unit 3: Stacks and Queues
3.1 ADT Stack and its operations
3.2 Applications of Stacks: Expression Conversion
3.3 Evaluation of Infix, prefix and Postfix Expression – corresponding algorithms and complexity analysis
3.4 Queues: Definition, Implementation of Linear Queues and Its Operations
3.5 Circular Queue, Priority Queues and Its Implementation
3.6 Linked representation of Stack and Queue
3.7 Queue Algorithms and their analysis
3.8 Applications of queues

PART-B

Unit 4: Trees
4.1 Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree
4.2 Binary Search Tree and its operations with complexity analysis
4.3 AVL Tree and its operations with complexity analysis
4.4 B Tree, B+ Tree: definitions, algorithms and analysis
4.5 Applications of Binary Trees

Unit 5: Graph
5.1 Basic Terminologies and Representations
5.2 Graph Traversals Algorithms: Breadth First and Depth First
5.3 Minimum Spanning Trees(Prim's and Kruskal's Algorithm)
5.4 complexity analysis of Graphs

Unit 6: Sorting and Hashing

6.1 Objective and properties of different sorting algorithms: Selection Sort
6.2 Bubble Sort, Insertion Sort
6.3 Quick Sort
6.4 Merge Sort, Heap Sort
6.5 Performance and Comparison among all the methods
6.6 Hashing

Text Books/ Reference Books:

1. Tenenbaum, A.M., 1990. Data structures using C. Pearson Education India.
2. Horowitz Ellis &Sartaj Sahni,1983. Fundamentals of Data Structures, Galgotria Pub
3. Aho Alfred V., Hopperoft John E., UIlman Jeffrey D.,1999. Data Structures and Algorithms, Addison Wesley
4. Jean Paul Tremblay, Richard B. Bunt, 2002, Introduction to Computers Science -An algorithms approach,T.M.H.
5. Ryba, A.J. and Kruse, R.L.K., 2007. Data structures and program design in C++. Prentice Hall.

Software required/Weblinks:

Turbo C
www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-301)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
BCS-DS-301.1	3	3	2	3	3	3	1	1	2	2	2	2	2	2	2
BCS-DS-301.2	3	3	3	3	2	3	1	2	2	2	1	2	2	2	2
BCS-DS-301.3	3	2	3	3	3	3	1	1	2	2	1	2	2	2	2
BCS-DS-301.4	3	3	3	3	3	3	1	1	2	3	1	2	2	3	2
BCS-DS-301.5	3	2	3	2	3	2	2	1	2	3	1	2	2	3	2
BCS-DS-301.6	3	3	3	3	3	3	2	2	2	3	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BEC-DS-322: DIGITAL ELECTRONICS AND CIRCUITS

Periods/week Credits Max. Marks : 200

L: 3 T: 0 3 | Continuous Evaluation : 100
Duration of Examination: 3 Hrs | End Sem Examination : 100

Pre-requisites: Basic Knowledge of computers
Course Type: Engineering Sciences

Course Outcomes : The students will be able to-
BEC-DS-322.1 Differentiate between various types of digital techniques.
BEC-DS-322.2 Design and implement combinational and sequential circuits.
BEC-DS-322.3 Analyze and implement various types of Flip Flops & counters.
BEC-DS-322.4 Discuss and distinguish the concepts of A/D and D/A converters.
BEC-DS-322.5 Explain logic families like TTL, ECL, NMOS, PMOS and CMOS and will be able to implement interface between TTL and CMOS.
BEC-DS-322.6 Appreciate and communicate the learning for catering to professional ethics and social needs.

PART-A

Unit 1: Fundamentals of Digital Logic Circuits
1.1 Digital Signals, Logic Gates, Concept of Universal Gates,Boolean algebra
1.2 Number Systems- Decimal, Binary, Signed Binary, Octal and Hexadecimal, Conversion of Bases
1.3 Binary Arithmetic, 2's Complement Arithmetic, BCD Arithmetic
1.4 Codes: BCD code, Excess-3 code, Gray code and Alpha-numeric codes
1.5 Error Detection and Correction: Parity Method, Hamming Code Method

Unit 2: Combinational Logic Design
2.1 Standard representation of logic functions: SOP & POS expression & Designing using Logic Gates
2.2 Boolean expression minimization techniques: K-Map (up to four variables) ,Quine-McCluskey Method
2.3 Adder: Binary Adder&Subtractor, BCD Adder &Subtractor
2.4 Digital Comparator, Multiplexer, De-multiplexer, Encoder, Decoder
2.5 Code Converters, Priority Encoder,BCD to 7 Segment Decoder
2.6 Design of Combinational Circuits using ROM, PAL and PLA

Unit 3: Flip-Flops
3.1 Combinational v/s Sequential Circuits
3.2 Latch v/s Flip-Flop
3.3 Types of Flip-Flops: S-R, J-K, D & T, Excitation Table of Flip Flops, Toggling & Race around Condition
3.4 Master Slave Flip-Flop
3.5 Clocked Flip-Flop Design: Conversion from one type of Flip-Flop to another type of Flip-Flop

PART-B

Unit 4: Sequential Logic Design
4.1 Introduction to Shift Registers & Types: SISO, SIPO, PISO and PIPO
4.2 Bidirectional Shift Register, Universal Shift Register
4.3 Synchronous v/s Asynchronous Counters
4.4 Asynchronous Counters: Ripple Counter, Decade Counter, Synchronous Counters: Ring and Johnson Counter
4.5 Designing of Asynchronous Counter, Designing of Synchronous Counter

Unit 5: A/D and D/A Converters
5.1 Requirement of A/D and D/A Conversion
5.2 Specifications of D/A Converters, Specifications of A/D Converters
5.3 Types of D/A Converter: Weighted Register Type, R-2R Ladder Type DAC
5.4 Types of A/D Converters: Successive Approximation Type, Parallel Comparator Type, Dual Slope, Counter Type ADC

Unit 6: Digital Logic Families
6.1 Unipolar and Bipolar Logic Families, Characteristics of Digital ICs
6.2 Bipolar Logic Families: TTL Configuration- Open Collector Output, Totem Pole Output, Tristate Output
6.3 ECL

6.4 Unipolar Logic Families: NMOS, PMOS, CMOS
6.5 Interfacing between TTL and CMOS

Text Books/ Reference Books:

1. William H. Gothmann, 2009 Digital Electronics: An Introduction To Theory And Practice, 2nd Edition, PHI Learning.
2. M. Morris Mano, Michael D Ciletti,2008, Digital Design, 4th Edition, Pearson.
3. Thomas L. Floyd, R. P. Jain, 2005, Digital Fundamentals, 8th Edition, Pearson.
4. John Morris, 1992, Digital Electronics, 1stEdition, Routledge.
5. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, 2009, Digital Systems, 10thEdition, Pearson.

Software required/Weblinks:
nptel.ac.in/courses/117101055

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix

CO Statement (BEC-DS-322)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PS 3**
BEC-DS-322.1	3	2	2	2	3	1	-	-	-	-	-	1	-	1	1
BEC-DS-322.2	3	2	3	3	3	-	-	-	-	-	-	1	1	1	2
BEC-DS-322.3	2	3	3	3	2	1	-	-	-	-	-	1	-	1	1
BEC-DS-322.4	1	2	3	2	3	1	-	-	-	-	-	1	-	1	2
BEC-DS-322.5	3	3	2	3	2	1	-	-	-	-	-	2	-	2	2
BEC-DS-322.6	1	1	1	1	1	2	2	3	3	3	2	2	1	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-302A: OBJECT ORIENTED PROGRAMMING

Periods/week Credits	Max. Marks	: 200
L :2 T: 1 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Core

Course Outcomes: Students will be able to -

BCS-DS-302A.1. Define the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects.

BCS-DS-302A.2. Understand dynamic memory management techniques using pointers, constructors, destructors, etc

BCS-DS-302A.3. Identify the concept of function overloading, operator Overloading, Virtual Functions and Polymorphism.

BCS-DS-302A.4. Categorize inheritance with the understanding of early and late binding, usage of exception handling, generic programming

BCS-DS-302A.5. Implement File Handling and stream file operations using Functions and their corresponding pointers also learn to handle errors in File handling.

BCS-DS-302A.6. Create the Template and Exception and Demonstrate concepts and functionalities of Try, Catch blocks and handle exceptions using throw and re-throw

PART A

Unit-1: Object Oriented Concepts

1.1 Procedure Oriented programming,
1.2 Introduction to Object Oriented Programming; Basic Concepts of OOPs: Class, Object, Data Abstraction, Encapsulation (Information Hiding),
1.3 Access modifiers: public, protected, private, package.
1.4 Polymorphism, Overloading; Inheritance, Reusability,
1.5 Dynamic Binding, Message Passing,
1.6 Benefits of OOPS concept,
1.7 Applications of OOP,
1.8 A simple C++ program, keywords, datatypes (basic, user-defined, derived)

Unit–2: Classes and Objects

2.1 Introduction to classes and objects.
2.2 Class Scope, Accessing class members: Variables and Methods.
2.3 Initializing class objects with constructors.
2.4 Default and Parameterized Constructor.
2.5 Constants variables and constant member functions.
2.6 Objects as members of class, Abstract Class.
2.7 friend function
2.8 Dynamic Memory Allocation.
2.9 Static Class Members, Proxy Classes, Destructors

Unit-3: Polymorphism

3.1 Concept of polymorphism.
3.2 function overloading
3.3 Constructor Overloading,
3.4 Operator overloading, Restrictions on Operator Overloading, Overloading operators: <<, >>, Unary Operators, Overloading Binary Operators.
3.5 Operator overloading using friend function.
3.6 Operator Functions as Class Members versus Friend Functions,

PART B

Unit-4: Inheritance

4.1 Introduction to Inheritance, Base Classes and Derived Classes.
4.2 Types of inheritance,
4.3 virtual function, Pure Virtual function,
4.4 Abstract base classes: Use of virtual functions in classes.
4.5 Pointer to derived class,
4.6 Use of Protected and Private Inheritance and Member Functions.
4.7 Overriding Base Class Members in a Derived Class,
4.8 Use of Constructors and Destructors in derived Classes,
4.9 Implicit Derived Class Object to Base Class Object Conversion,
4.10 Composition versus Inheritance.

Unit-5: File Handling

5.1 Introduction of file handling, Classes and file stream operations,
5.2 Creating sequential files, reading and writing files,
5.3 Opening and closing of file, detecting the end of file.
5.4 File Modes: sequential and random file modes.
5.5 File pointers and their manipulations,
5.6 Sequential input and output operations,
5.7 Updating a file: sequential and random access files,
5.8 Error handling during file operations.

Unit-6: Templates & Exception Handling

6.1 Function Templates, Overloading Function Template,
6.2 Class Template, Class Templates and Non-Type Parameters,
6.3 Templates and Inheritance, Templates and Friend classes, Templates and Static Members,
6.4 Introduction of Exception Handling, Exception Handling mechanisms: Try, Throw, Catch.
6.5 Throwing an Exception, Catching an Exception,
6.6 Re-throwing an Exception, Exception specifications,
6.7 Processing Unexpected Exceptions,
6.8 Use of exceptions in inheritance.

Text Books / Reference Books:

1. Robert Lafore, 2001, object Oriented Programming in Turbo C++, 4th Ed., Pearson Education.
2. E Balagurusamy, 2013, Object oriented Programming with C++, 6th Ed., TMH.
3. Horstmann, 2008, Computing Concepts with C++ Essentials, 2nd Ed., John Wiley.
4. Bhave, 2012, Object Oriented Programming in C++, 2nd Ed., Pearson.
5. D Ravichandran, 2003, Programming with C++, 3rd Ed., TMH.
6. Herbert Schildt, 2005, The Complete Reference in C++, 4th Ed., TMH.

Software required/Weblinks:

C/C++ (TurboC/DOS BOX)
www. 3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

(BCS-DS-302)														
BCS-DS-302A.1	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-
BCS-DS-302A.2	-	1	3	-	1	-	-	-	-	-	-	-	-	-	-
BCS-DS-302A.3	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-
BCS-DS-302A.4	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-
BCS-DS-302A.5	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
BCS-DS-302A.6	-	-	2	3	3	2	3	-	-	-	-	2	2	3	2

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BHM-001A: CYBER LAW & ETHICS

Periods/week Credits	Max. Marks : 200
L :2 T: 0 2.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Basic Knowledge of networks

Course Type: HSMC

Course Outcomes: The students will be able to-
BHM-001A.1 Understand Networking basics and the various networking utilities
BHM-001A.2 Understand the importance of information security
BHM-001-A.3 Identify the various Internet frauds and various types of attacks faced by a Network.
BHM-001A.4 Analyze the various cyber laws and its impact over society.
BHM-001A.5 Evaluate the ethics, privacy rights and audits in cyber security.
BHM-001A.6 Create the various Information Technologies Acts and rights.

PART – A

Unit 1: Networks and the Internet

1.1 Introduction to Network Basics,
1.2 General Architecture of Internet,
1.3 IP Addresses.
1.4 Uniform Resource Locators and their role,
1.5 Basic Network Utilities, IP Config, Ping, Tracert.

Unit 2: Introduction to Computer Security

2.1 Importance of Information and its Security,
2.2 Types of Threats: Malware, Denial of Service Attacks, Web Attacks, Session Hijacking, DNS Poisoning;
2.3 Basic Security Terminology.

Unit 3: Cyber Attacks

3.1 Introduction to Internet Frauds, Phishing, Cyber Stalking, Types of Attacks: Investment Offers, Auction Frauds, Identity Theft,
3.2 Protecting Yourself against Cyber Crime, Protecting against Investment Fraud, Protecting against Identity Theft,
3.3 Secure Browser Settings.
3.4 cyber laws and their scope and coverage,

PART – B

Unit 4: Computer and its impact in Society

4.1. Need for Cyber Law in 21st century
4.2. Development of Cyber Law in India

Unit 5: Privacy Issue and Access Rights

5.1. Introduction to Cyber Ethics
5.2. Freedom of Speech and Expression in Cyber Space
5.3. Right to Privacy and Right to Data protection
5.4. Cyber Security Audit

Unit 6: Information and Technology Act & Intellectual Property Rights

6.1. Historical Background and objectives
6.2. Legal Recognition of Electronic Record & Procedure
6.3. Offences and Penalties.

Text Books / Reference Books:

1. William Easttom, 2011, Computer Security Fundamentals, 2nd ed, Pearson.
2. Dr. Pramod Kr. Singh, 2007, Laws on Cyber Crimes, Book Enclave, Jaipur
3. Mark. F. Grady and Francesco Parisi, 2006, The Law and Economics of Cyber Security, Cambridge University Press.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BHM-001A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BHM-001A.1	3	2	1	-	-	-	-	-	--	-	-	-	3	3	3
BHM-001A.2	-	-	2	-	-	-	-	-	1	-	-	2	2	2	2
BHM-001A.3	-	-	-	-	-	-	3	-	2	1	-	-	1	2	1
BHM-001A.4	-	-	-	-	3	2	-	-	-	2	2	1	3	3	3
BHM-001A.5	-	-	2	-	-	-	-	1	-	-	1	-	3	3	3
BHM-001A.6	-	-	-	-	-	-	2	-	1	2	-	-	1	1	2

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NAAC 'A++' Grade University

BMA-303A: Mathematics-3 (Multivariate Calculus)

Periods/week Credits
L: 2 T: 1 3
Duration of Examination: 3 Hrs

Max. Marks : 200
Continuous Evaluation : 100
End Semester Examination: 100

Pre-requisites: The students must have the knowledge of basic concepts of calculus of Intermediate level.
Course Type: Basic Sciences
Course Coordinator:

Course Outcomes: Students will be able to

BMA-303A.1 Students will be able to express functions in terms of infinite series and test their convergence.
BMA-303A.2 Students will be able to solve linear differential equations.
BMA-303A.3 Students will be able to apply the use of multivariate calculus in solving engineering problems.

PART-A

Unit 1: Sequences and series
Tests for convergence: p-test, comparison test, D'Alembert ratio test, Raabe's test, logarithmic test, Cauchy's root test, Alternating series, conditional and absolute convergence.

Unit 2: Multivariable Calculus (Differentiation)
Partial derivatives, total derivative, Jacobians, Maxima, minima for two variables, Method of Lagrange multip gradient, directional derivatives, curl and divergence.

PART-B
Unit 3: First Order Ordinary Differential Equations
Exact differential equation, Equations not of first degree: equations solvable for p, equations solvable f equations solvable for x and Clairaut's type

Unit 4: Ordinary Differential Equations of Higher Orders
Linear differential equation with constant coefficient, method of variation of parameters, Cauchy-Euler equation, Simultaneous linear differential equations.

Suggested Text/Reference Books

1. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Editi Wiley India, 2009.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B(one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Assessment Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Term Examination.

Course Articulation Matrix:

CO Statement (BMA-303A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BMA-303A.1	3	3	1	2	2	--	--	--	--	--	--	2	--	--	--
BMA-303A.2	3	3	1	2	2	--	--	--	--	--	--	1	--	--	--
BMA-303A.3	3	3	2	2	3	--	--	--	--	--	--	2	--	--	--

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-351: DATA STRUCTURES & ALGORITHMS LAB

Periods/week	Credits	Max. Marks	: 100
P :2	1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Data Structures & Algorithms (BCS-DS-301)
Course Type: Program Core

Course Outcomes: The students will be able to-

BCS-DS-351.1	Define the iterative and recursive approach
BCS-DS-351.2	Understand the various Data structures using C
BCS-DS-351.3	Deploy the advance C programming techniques such as pointers, dynamic memory allocation, and structures to developing solutions for particular problems
BCS-DS-351.4	Analyze various operation performed on elementary data structures
BCS-DS-351.5	Select the appropriate data structures based upon problem environment
BCS-DS-351.6	Design the solutions for the real-world problems

List of Practicals:

1. (a) Write a program to find factorial of a number through iterative method.
   (b) Write a program to find factorial of a number through recursion.

2. (a) Write a program to print the Fibonacci series through iterative method.
   (b) Write a program to print the Fibonacci series through recursion.
3. (a) Write a program to find an element in linear array using linear search.
   (b) Write a program to find an element in multi-array using linear search.
4. (a) Write a program to find an element in linear array using Binary search(Iterative).
   (b) Write a program to find an element in linear array using Binary search(Recursive).
5. Write a program to implement stack data structures statically and perform the following functions:
   a) Insertion b) Deletion c) Traversing
6. Write a program to convert infix notation to postfix notation using stack (application of stack).

7. Write a program to evaluate infix notation using stack (application of stack).

8. Write a program to implement linear queue data structures statically and perform the following functions:
   a) Insertion b)Deletion c)Traversing
7. Write a program to implement circular queue data structures statically and perform the following functions:
   a) Insertion b) Deletion c)Traversing
8. Write a program to implement dequeue(double ended queue)data structures statically. Ask from user for the type of dequeue to be implemented and call the functions accordingly.
9. Write a program for a menu-driven program that enable user to implement linked-list with all possible operations:
   a) Insertion at end b)Insertion at beginning c)Insertion at Specified Position
   d) Deletion at end e) Deletion at beginning f)Deletion at Specified Position
   g) Traversing h) Counting the nodes
10. Write a program for a menu-driven program that enable user to implement circular linked-list with all possible operations:
   b) Insertion at end b)Insertion at beginning c)Insertion at Specified Position
   e) Deletion at end e) Deletion at beginning f)Deletion at Specified Position
   h) Traversing h) Counting the nodes
11. Write a program for a menu-driven program that enable user to implement doubly linked-list with all possible operations:
   c) Insertion at end b)Insertion at beginning c)Insertion at Specified Position
   f) Deletion at end e) Deletion at beginning f)Deletion at Specified Position
   i) Traversing h) Counting the nodes
12. Write a program for various tree traversal algorithms (Pre, Post, In order) using two dimensional representations for trees.
13. Write a program to simulate BFS graph traversing algorithms.
14. Write a program to simulate DFS graph traversing algorithms.
15. Write a program to implement MST using Prim's Algorithms
16. Write a program to implement MST using Kruskals's Algorithms
17. Write a Program to sort data using
    a) Selection Sort
    b) Insertion Sort
    c) Bubble Sort
    d) Quick Sort
    e) Merge Sort
    f) Heap Sort

Software required/Weblinks:
Turbo C
www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%

File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-351)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-351.1	3	3	3	3	3	3	1	1	2	2	2	2	2	2	2
BCS-DS-351.2	3	3	3	3	3	3	1	2	2	2	1	2	2	2	2
BCS-DS-351.3	3	3	3	3	3	3	2	1	2	2	1	2	2	2	2
BCS-DS-351.4	3	3	3	3	3	3	1	2	2	2	1	2	2	3	2
BCS-DS-351.5	3	3	3	3	3	3	2	2	2	2	1	2	2	3	2
BCS-DS-351.6	3	3	3	3	3	3	2	2	2	3	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BEC-DS-362: DIGITAL ELECTRONICS AND CIRCUITS LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-requisites: Digital Electronics and Circuits (BEC-DS-322)
Course Type: Engineering Science

Course Outcomes: The students will be able to:
BEC-DS-362.1. Execute the operations of various TTL gates.
BEC-DS-362.2. Apply K map minimizing procedures for circuit realization.
BEC-DS-362.3. Analyze and implement combinational circuits.
BEC-DS-362.4. Analyze and implement various sequential circuits.
BEC-DS-362.5. Demonstrate the working of various logic families.
BEC-DS-362.6. Appreciate and communicate the learning for catering to professional ethics and societal needs.

List of Experiments:
1. To verify the truth tables of TTL gates: AND, OR, NOT, NAND, NOR & EX-OR Gates.
2. To design and realize a Boolean function using K map.
3. To realize half/full adder and half/full subtractor using:
   i. X-OR and basic gates ii. Only NAND gates.

4. To verify the operation of Multiplexer and Demultiplexer.
5. To verify BCD to excess –3 code conversion using NAND gates
6. To verify the truth table of comparator.
7. To verify the truth tables of S-R, J-K, T and D type flip flops.
8. To verify the operation of bi-directional shift register.
9. To design and verify the operation of 3-bit synchronous counter.
10. To design the operation of a Ring counter.
11. To design the operation of a Johnson counter.
12. To design and verify the operation of asynchronous UP / DOWN decade counter using J-K flip flops.
13. To design and verify the operation of synchronous UP / DOWN decade counter using J-K flip flops.
14. To design and realize a sequence generator for a given sequence using J-K flip flops.

PROJECTS BASED ON ABOVE EXPERIMENTS:

1. Design various logic gates using transistor
2. Design and verify the operation of 2-bit synchronous counter using JK flip flops
3. Design a binary to gray code converter using gates
4. Design visitor counter using BCD to 7 Segment Display
5. Design and verify the operation of logic gates using Multiplexer

NOTE: Every student needs to do minimum 10 numbers of experiments/practicals and 1 project in a semester. 20% new experiments should be added every year.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

Course Articulation Matrix

CO Statement (BEC-DS-362)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BEC-DS-362.1	3	3	2	2	3	-	-	-	-	-	-	2	-	1	1
BEC-DS-362.2	3	3	2	2	3	-	-	-	-	-	-	2	1	1	2
BEC-DS-362.3	3	3	3	3	3	-	-	-	-	-	-	2	-	1	1
BEC-DS-362.4	3	3	3	2	3	-	-	-	-	-	-	2	-	1	2
BEC-DS-362.5	3	3	2	2	3	-	-	-	-	-	-	2	-	2	2
BEC-DS-362.6	1	1	1	1	1	3	3	3	3	3	3	2	1	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-352: OBJECT ORIENTED PROGRAMMING SYSTEMS LAB

Periods/week	Credits	Max. Marks	: 100
P :2	1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Object Oriented Programming (BCS-DS-302)
Course Type: Program Core

Course Outcomes: Students will be able to -

BCS-DS-352.1	Define the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects.
BCS-DS-352.2.	Understand the concept of dynamic memory management techniques using pointers, constructors, destructors, etc
BCS-DS-352.3.	Apply function overloading, operator Overloading, Virtual Functions and Polymorphism.
BCS-DS-352.4.	Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming
BCS-DS-352.5.	Evaluate File Handling and stream file operations using Functions and their corresponding pointers also learn to handle errors in File handling.
BCS-DS-352.6.	Design the Template and Exception and Demonstrate concepts and functionalities of Try, Catch blocks and handle exceptions using throw and re-throw.

List of Practicals:

Q1. Raising a number n to a power p is the same as multiplying n by itself p times. Write a function called power ( ) that takes a double value for n and an int value for p, and returns the result as double value. Use a default argument of 2 for p, so that if this argument is omitted, the number will be squared. Write a main ( ) function that gets values from the user to test this function.

Q2. A point on the two dimensional plane can be represented by two numbers: an X coordinate and a Y coordinate. For example, (4,5) represents a point 4 units to the right of the origin along the X axis and 5 units up the Y axis. The sum of two points can be defined as a new point whose X coordinate is the sum of the X coordinates of the points and whose Y coordinate is the sum of their Y coordinates.
Write a program that uses a structure called point to model a point. Define three points, andhavethe user input values to two of them. Then set the third point equal to the sum of the other two, and display the value of the new point. Interaction with the program might look like this:

Enter coordinates for P1: 3 4
Enter coordinates for P2: 5 7
Coordinates of P1 + P2 are : 8, 11

Q3. Create the equivalent of a four function calculator. The program should request the user to enter a number, an operator, and another number. It should then carry out the specified arithmetical operation: adding, subtracting, multiplying, or dividing the two numbers. (It should use a switch statement to select the operation). Finally it should display the result.
When it finishes the calculation, the program should ask if the user wants to do another calculation. The response can be 'Y' or 'N'. Some sample interaction with the program might look like this.

Enter first number, operator, second number: 10/ 3
Answer = 3.333333
Do another (Y/ N)? Y
Enter first number, operator, second number 12 + 100
Answer = 112
Do another (Y/ N) ? N

Q4. Phone number, such as (212) 767-8900, can be thought of as having three parts: the area code (212), the exchange (767) and the number (8900). Write a program that uses a structure to store these three parts of a phone number separately. Call the structure phone. Create two structure variables of type phone. Initialize one, and have the user input a number for the other one. Then display both numbers. The interchange might look like this:

Enter your area code, exchange, and number: 415 555 1212
My number is (212) 767-8900
Your number is (415) 555-1212

Q5. Create two classes DM and DB which store the value of distances. DM stores distances in metres and centimeters and DB in feet and inches. Write a program that can read values for the class objects and add one object of DM with another object of DB.
Use a friend function to carry out the addition operation. The object that stores the results maybe a DM object or DB object, depending on the units in which the results are required.
The display should be in the format of feet and inches or metres and cenitmetres depending on the object on display.

Q6. Create a class rational which represents a numerical value by two double values- NUMERATOR & DENOMINATOR. Include the following public member Functions:

- constructor with no arguments (default).
- constructor with two arguments.
- void reduce( ) that reduces the rational number by eliminating the highest common factor between the numerator and denominator.
- Overload + operator to add two rational number.
- Overload >> operator to enable input through cin.
- Overload << operator to enable output through cout.

Write a main ( ) to test all the functions in the class.

Q7. Consider the following class definition

```
class father {
protected :int age;
public;
  father (int x) {age = x;}
  virtual void iam ( )
  { cout<< "I AM THE FATHER, my age is : "<< age<< end1:}
          };
```

Derive the two classes son and daughter from the above class and for each, define iam ( ) to write our similar but appropriate messages. You should also define suitable constructors for these classes. Now, write a main ( ) that creates objects of the three classes and then calls iam ( ) for them. Declare pointer to father. Successively, assign addresses of objects of the two derived classes to this pointer and in each case, call iam ( ) through the pointer to demonstrate polymorphism in action.

Q8. Demonstrate C++ program to read and print **student's information and their parents information** using two classes. Student class and parent class detail of the classes are
Student class: Name, Age, Course, Marks in 12^{th}, rank
Parent class: Name, Age, Profession, address, qualification

Q9. Write a program that creates a binary file by reading the data for the students from the terminal. The data of each student consist of roll no., name (a string of 30 or lesser no. of characters) and marks.

Q10. A hospital wants to create a database regarding its indoor patients. The information to store include
a) Name of the patient
b) Date of admission
c) Disease
d) Date of discharge

Create a structure to store the date (year, month and date as its members). Create a base class to store the above information. The member function should include functions to enter information and display a list of all the patients in the database. Create a derived class to store the age of the patients. List the information about all to store the age of the patients. List the information about all the pediatric patients (less than twelve years in age).

Q11. Make a class **Employee** with a name and salary. Make a class **Manager**inherit from **Employee**. Add an instance variable, named department, of type string. Supply a method to **toString** that prints the manager's name, department and salary. Make a class **Executive** inherit from **Manager**. Supply a method **to String** that prints the string **"Executive"** followed by the information stored in the **Manager** superclass object. Supply a test program that tests these classes and methods.

Q12. Imagine a tollbooth with a class called toll Booth. The two data items are a type unsigned int to hold the total number of cars, and a type double to hold the total amount of money collected. A constructor initializes both these to 0. A member function called payingCar ( ) increments the car total and adds 0.50 to the cash total. Another function, called nopayCar ( ), increments the car total but adds nothing to the cash total. Finally, a member function called displays the two totals.
Include a program to test this class. This program should allow the user to push one key to count a paying car, and another to count a nonpaying car. Pushing the ESC kay should cause the program to print out the total cars and total cash and then exit.

Q13. Write a function called reversit( ) that reverses a string (an array of char). Use a for loop that swaps the first and last characters, then the second and next to last characters and so on. The string should be passed to reversit ( ) as an argument.
Write a program to exercise reversit ( ). The program should get a string from the user, call reversit ( ), and print out the result. Use an input method that allows embedded blanks. Test the program with Napoleon's famous phrase, "Able was I ere I saw Elba)".

Q14. Create some objects of the string class, and put them in a Deque-some at the head of the Dequeand some at the tail. Display the contents of the Deque using the forEach ( ) function and a user written display function. Then search the Deque for a particular string, using the first That ( ) function and display any strings that match. Finally remove all the items from the Deque using the getLeft ( ) function and display each item. Notice the order in which the items are displayed: Using getLeft ( ), those inserted on the left (head) of the Deque are removed in "last in first out" order while those put on the right side are removed in "first in first out" order. The opposite would be true if getRight ( ) were used.

Q15. Create a base class called shape. Use this class to store two double type values that could be used to compute the area of figures. Derive two specific classes called triangle and rectangle from the base shape. Add to the base class, a member function get_data ( ) to initialize base class data members and another member function display_area ( ) to compute and display the area of figures. Make display_area ( ) as a virtual function and redefine this function in the derived classes to suit their requirements. Using these three classes, design a program that will accept dimensions of a triangle or a rectangle interactively and display the area.
Remember the two values given as input will be treated as lengths of two sides in the case of rectangles and as base and height in the case of triangles and used as follows:

Area of rectangle = $x * y$
Area of triangle = $½ * x * y$

Software required/Weblinks:
C/C++(TurboC/DOS BOX)
www. 3schools.com

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-352)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-352.1	3	3	3	2	2	2	2	2	2	2	2	2	2	2	1
BCS-DS-352.2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	1
BCS-DS-352.3	3	3	3	2	2	2	2	2	2	2	2	2	1	2	1
BCS-DS-352.4	3	3	3	2	2	2	2	2	2	2	2	2	2	2	1
BCS-DS-352.5	3	3	3	2	2	2	2	2	2	2	2	2	2	2	1
BCS-DS-352.6	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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NAAC 'A' Grade University

DTI -300: Design, Thinking and Innovation-I

Periods/week	Credits	Max. Marks : 50
L:0 T:1 P:0	1	Continuous Assessment : 50

Pre-requisites: Nil
Course Type: HSMC
Course Coordinator: Mr. Yaman Hooda

Course Outcomes:
DTI300.1. To explore different sources for generating ideas for Research.
DTI300.2.To understand the problem classification based on domain specific resources.
DTI300.3. To realize the design thinking stages.
DTI300.4. Topresent critical analysis of literature survey.

Activity 1: Motivation

1.1 Divergent thinking and brain storming
1.2 Creative process

Activity 2: Introduction to Design Thinking

2.1 Empathize Mode
    2.1.1 Discussions and deliberations
2.2 Define Mode
2.3 Ideate Mode
    2.3.1Contemporary Relevance.

2.3.2 Tools and techniques for generating ideas
2.3.3 Idea Challenges

Activity 3: Problem Classification

3.1 Domain Classification.
3.2 Identification of Mentors

Activity 4: Problem identification

4.1 Literature survey and option analysis.
4.2 Feasibility study.
4.3 Formulation of problem statement.
4.4Expected Outcome / Model of the problem.
4.5 Planning Matrix

Activity5: Presenting the Ideation

5.1 Structuring and preparation of PPT
5.2 Review on presentation skills and content delivered
5.3 Incorporating the review comments.

Course Articulation Matrix:

CO Statement (DTI-300)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
DTI 300.1	1	2	-	-	1	-	2	3	3	3	2	2	-	3
DTI 300.2	2	3	-	-	2	3	3	2	2	2	2	3	3	-
DTI 300.3	3	3	1	2	3	2	2	3	2	-	-	2	2	2
DTI 300.4	3	3	1	2	3	3	2	3	3	-	2	2	3	-

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No:	Parameters	Description	Marks	
1.	Attendance	Percentage of classes attended by the students	5	5
2.	Continuous Performance	Group participation and response of the students to a given task:		15
		Judge individual student in the group	5	
		Meeting timelines as per activity plan	10	
3.	Literature Review	Student interaction with faculty mentors	5	15
		Relevance of the topic	3	
		Usage of Scientific Literature Databases. e.g., Scopus/ Web of Science/ etc.	2	
		Number of relevant papers / design referred for the given topic	5	
4.	PPT & Report	Report structure and Slide sequence	5	15
		Contribution of individual group member towards the presentation and report	5	
		Scientific/Technical writing	5	
		Max. Marks	**50**	**50**

References:

1. http://nptel.ac.in/courses/121106007/
2. http://public.wsu.edu/~taflinge/research.html

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BHM-MC-002: SPORTS AND YOGA

Periods/week Credits Max. Marks : 100
L: 2 T: 0 0 Continuous Evaluation : 100

Duration of Examination: 1Hr

Pre-requisite: None
Course Type: Audit pass (HSMC)

Course Outcomes: The course will enable the student to-
BHM-MC-002.1. Understandtheimportanceofsoundhealthandfitnessprinciplesastheyrelate tobetterhealth.
BHM-MC-002.2.Participate in variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.

Unit 1: IntroductiontoPhysicalEducation, Wellness&Lifestyle(6 Lectures)
Meaning&definitionofPhysicalEducation, Aims&ObjectivesofPhysicalEducation,changingtrendsinPhysicalEducation, Meaning&ImportanceofPhysicalFitness&Wellness, ComponentsofPhysical fitness, Healthrelatedfitness and wellness, PreventingHealthThreatsthroughLifestyleChange, ConceptofPositive Lifestyle.

Unit 2: FundamentalsofAnatomy&PhysiologyinPhysicalEducation,Sports&Yoga(8 Lectures)
DefineAnatomy,Physiology&ItsImportance, EffectofexerciseonthefunctioningofVariousBodySystems (CirculatorySystem,RespiratorySystem,Neuro-MuscularSystemetc.), MeaningandConceptofPostures, CausesofBadPosture, Advantages&disadvantagesofweighttraining., Concept&advantagesofCorrectPosture, CommonPosturalDeformities–KnockKnee;FlatFoot;RoundShoulders;Lordosis, Kyphosis,BowLegsandScoliosis, CorrectiveMeasuresforPosturalDeformities.

Unit 3: Yoga&Lifestyle(6 Lectures)
ElementsofYoga, Introduction-Asanas,Pranayama,Meditation&YogicKriyas, Yogaforconcentration&relatedAsanas, RelaxationTechniquesforimprovingconcentration -Yog-nidra, Asanasaspreventivemeasures.

Unit 4: Training, Planning &PsychologyinSports(8 Lectures)
MeaningofTraining, warmingupandlimberingdown, Skill,Technique& Style, MeaningandObjectivesofPlanning, Tournament–Knock-Out,League/RoundRobin&Combination. Definition&ImportanceofPsychologyinPhysicalEdu.&Sports, Define&DifferentiateBetweenGrowth&Development, AdolescentProblems&TheirManagement, Psychologicalbenefitsofexercise.

TextBooks/References:

1. Ajmer Singh and Rachhpal Singh Brar, 2019, Essentials ofPhysicalEducation, Kalyani Publishers.
2. B.K.S.Iyengar, 2015, Yoga for Sports, Westland publications.

Evaluation Tools:

Class Quiz, Rubrics

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BHM-MC-004: QUANTITATIVE APTITUDE

Periods/week	Credits	Max. Marks : 100
P :2	0	
		Continuous Evaluation: 50
Duration of Exam: 2 Hrs		End Sem Examination : 50

Pre-Requisite: Basic Knowledge of XII standard maths
Course Type: HSMC

Course Outcomes: Students will be able to-
BHM-MC-004.1. Recognize problems based on arithmetic & number system.
BHM-MC-004.2. Solve problems based on verbal reasoning & simplification.
BHM-MC-004.3. Calculate the correct answers to the problems within given time.
BHM-MC-004.4. Plan their career meticulously by setting their time oriented goals.
BHM-MC-004.5. Introspect and enhance their personality.
BHM-MC-004.6. Develop cultural sensitivity and communicate respectfully across cultures.

PART – A

Unit 1: Number System 1
1.1 Vedic Mathematics
 1.1.1 Basic of mathematics
 1.1.2 Addition and subtraction using Vedic Mathematics
 1.1.3 Multiplication of two and three numbers.
1.2 Simplification
 1.2.1 BODMAS rule
 1.2.2 Fractions and recurring decimals
 1.2.3 Surds and indices
1.3 Numbers
 1.3.1 Types of numbers and number tree
 1.3.2 Divisibility Rule
 1.3.3 HCF & LCM

Unit 2: Verbal Reasoning 1
2.1 Direction Sense Test
2.2 Blood Relation Test

Unit 3: Arithmetic 1
3.1 Problem on Ages
3.2 Problem on Numbers
3.3 Averages

PART – B

Unit 4: Career Planning

4.1 **Career planningProcess** - Self Assessment, Research, Decision Making, Action and Employability

4.2 **Goal Setting:** Relevance, SMART goals, The Dos & Don'ts

Unit 5: Personality Enhancement

5.1 **Emotional Intelligence:** Emotional Self -Awareness, Self- Control, Emotional Management

5.2 **Stress Management:** What is Stress, Types of Stress, Stress Response Example, Vulnerability to Stress, Why do we Stress out, Stress Warning Symbols, Suggestions for Reducing Stress,

5.3 **Time Management:** Setting Priorities, Managing Time, Four Quadrants of Time Management

5.4. **Team Building:** Definition –Team, Characteristics of effective Teams, Competence, Clear and Compelling goal, Supportive Environment, Alignment, Designing the Team, Identifying Roles and Responsibilities, Determining Reward, Troubleshooting Guide, Good Team member

Unit 6: Effective Communication

6.1 **Courtesy in Communication:** Being Polite, Self -Discipline, Respecting Others and understanding other's perspective in communication

6.2 **Inter cultural Communication:** Breaking Stereotypes, Diversity Inclusion and Cultural Sensivity

Text Books/Reference Books:

1. R S Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations, S Chand &Company Pvt Ltd
2. R S Aggarwal, 2018, A Modern Approach to Verbal& Non Verbal Reasoning, S Chand &Company PvtLtd.
3. Mark A Griffin, College to Career: The Student Guide to Career and Life Navigation.
4. Anthony Gutierez, Effective Communication in the Workplace.

Instructions for paper setting: Fifty MCQ will be set in total. TwentyFiveMCQwillbe set from Part A and Twenty Five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix:

CO Statement (BHM-MC-004)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BHM-MC-004.1	1	-	-	2	-	-	-	-	-	-	-	-	-	-	1
BHM-MC-004.2	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1
BHM-MC-004.3	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
BHM-MC-004.4	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-
BHM-MC-004.5	-	-	-	-	-	-	-	1	3	3	-	1	-	-	-
BHM-MC-004.6	-	-	-	-	-	-	-	1	2	3	-	1	-	-	-

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Proj-CS-300A: SUMMER INTERNSHIP –I

Periods/week	Credits	Max. Marks	:50
2 weeks Minimum	1.0	Continuous Evaluation	: 50

Duration of Exam: 2 Hrs

Pre-Requisite: Basic Knowledge of computers
Course Type: Projects

Course Outcomes: Students will be able to-
Proj-CS-300A.1. Recognize the real field challenges.
Proj-CS-300A.2. Apply their learning skills for real- life problem solution.
Proj-CS-300A.3. Identify their areas of interest in research.
Proj-CS-300A.4. Enhance their innovative skills.
Proj-CS-300A.5. Develop solutions for specific problem.
Proj-CS-300A.6. Prepare a summarized report.

i. Introduction to Git and Github

Requirements: Lab with Linux OS installed. Preferably Ubuntu 18.04 LTS
Contents
Day 1: Setting up a local repository & remote repository
gitinit
git clone
gitconfig
git alias
Commands on github

Day 2: Saving Changes
git add
git commit
git diff
git stash
gitigore
commands on git hub

Day 3: Inspecting a repository
git status
git tag
git blame
git branch
commands on git hub

Day 4: Undoing Changes
git checkout
git clean
git revert
git reset
gitrm

Day 5: Rewriting History
git commit –amend
git rebase

git rebase -i
gitreflog

ii. Presentation

Presentation topics can include:
a. Developing a professional profile with LinkedIn
b. Supply Chain Management
c. Free and Open Source Software's
d. Introduction to GitHub and SourceForge.net
e. Storage Technologies
f. Geographical Information System
g. IDS and Firewalls
h. Professional certifications in the area of Networks and their requirements (Cisco, Redhat)
g. Professional certifications in the area of Cloud Computing and their requirements
h. Professional certifications in the area of Cyber security and their requirements
i. Professional certifications in the area of Graphics and Gaming
j. Professional certifications in the area of Big Data Analytics
k. Industry 4.0
l. Academics 4.0
m. Intrusion detection system
n. Software reverse engineering
o. Mobile operating systems
p. linux variants
q. Virtualization technologies
r. Open Source libraries for graphics (OpenGL)
s. Technologies involved in Cloud Setup
t. Alternative to Microsoft office software and their comparison
u. Open Source Software based firewalls and their setup
v. Digital Marketing: applications and processes
w. Customer Identity Access Management
x. Netowrk monitoring : softwares, implementations and applications
y. Chatbots: Introduction, working and applications
z. Ngix Server: Introduction, working and Applications
aa. Free and open source based plot libraries
ab. Linux Kernel Programming
ac. Real Time Operating system
ad. Free and open source based antivirus softwares
ae. e-learning platforms for technical courses and their comparison
af. e-learning technologies for the course development and hosting

iii. Course Title: Javascript Programming

Pre-requisites: c(or any programming language), HTML5, CSS, XML
Requirements: System with notepad and internet connection
Objective: The candidate should be able to understand the key technologies involved in web development including javascript, bootstrap, jquery and angular js. The student will be able to develop the web based solution, after the successful completion of the course.
Unit1: Getting Started (2 Hours): JavaScript Foundation, Variables, Boolean, Operators(Mathematical, logical, relational, bitwise), Control Flow, Functions and methods, data type conversion, input and output, date and time functions.
Unit2: Scope, Arrays and Iterations (2 hours): Scope of variable, 1/2/3 dimensional arrays, loop statements (for, while), functions, alterts, prompts,
Unit3: Objects, Errors and Debugging (2 hours): Objeccts, Advanced objects and this keywords, erro, error handling, pattern Matching
Unit4: Document Object Model(2 hours):browser and javascript, getting access to the form elements, setting the properties of elements at run time, handling page events, Cookies, Introduction to Ajax
Unit5: Jquery (2 hours):Getting started, selectors, events, effects, get/set/add/remove, CSS classes, dimensions, traversal.
Unit6: Responsive web design (2 hours):Introduction to RWD, bootstrap Frameworks, typographic, colors, tables, buttons, images, jumbotron, cards, navs, navbar, badges, Collaps, Carousel, toast, scrollspy.
Unit7: Angular JS (2 hours): Introduction, expressions, modules, directives, model, data binding
Unit8: Angular JS (2hours): Controllers, scopes, filters, services, http, tables, select, DOM, Events, Forms,

Validation
Unit9: Angular JS(2hours): include, animations, routing
Unit10: Revision and small project (2 hours)

iv. **Course Title**: **C Programming**

Pre-requisites: NIL
Requirements: internet connection
C program to solve Polynomial and Differential Equations.
C program to declare memory for an integer variable dynamically.
C program to read and print name, where memory for variable should be declared at run time.
C program to find sum of array elements using Dynamic Memory Allocation.
C Program to find the sum of digits of a number until a single digit is occurred.
C program to find class of an IP Address.
C program to print weekday of given date.
EMI Calculator (C program to calculate EMI).
Implement Tic Tac Toe.
Implement stone paper scissor game.
To implement Quick sort.
To implement structure of an employee using Pointers.

Distribution of Continuous Evaluation:

Presentation/Viva	40%
Report	20%
Class Work/ Performance	20%
Attendance	20%

COURSE ARTICULATION MATRIX :

CO Statement (Proj-CS-300)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
Proj-CS-300A.1	1	2	3	-	-	-	2	2	3	3	2	3	1	2	3
Proj-CS-300A.2	1	3	3	-	-	-	2	3	3	2	2	3	1	2	3
Proj-CS-300A.3	2	-	-	-	-	-	2	1	2	3	2	3	1	2	3
Proj-CS-300A.4	1	-	-	-	-	-	2	1	3	3	2	3	1	2	2
Proj-CS-300A.5	2	-	-	-	-	-	2	2	3	2	2	3	2	-	3
Proj-CS-300A.6	1	-	-	-	-	-	2	2	3	2	2	3	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BCS-DS-527: CLOUD COMPUTING ARCHITECTURE AND DEPLOYMENT MODELS (CC)

Periods/week Credits	Max. Marks	: 200
L :2 T: 0 2.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basics of Virtualization
Course Type: Program Core

Course Outcomes: Students will be able to-

BCS-DS-527.1	Understand the basics of cloud computing
BCS-DS-527.2	Explain cloud service model.
BCS-DS-527.3	Describe cloud computing reference architecture.
BCS-DS-527.4	Illustrate open stack architecture.
BCS-DS-527.5	Articulate public cloud deployment model.
BCS-DS-527.6	Relate the cloud service working models in public cloud environment.

PART-A

Unit-1: Overview of Delivery models in Cloud Computing

1.1 Cloud Computing Platform Overview, Why Cloud Computing?,
1.2 Evolution of Cloud Computing, What is Cloud Computing?,
1.3 Cloud Computing Definition and Characteristics, Definition of Cloud Computing, Essential characteristics of Cloud Computing,
1.4 Types of Cloud, Cloud Computing Advantages, Illustration of the benefits of cloud computing , Cloud Computing Challenges,
1.5 Illustration of cloud computing challenges, Cloud Computing Service models, Cloud Computing Deployment models, Cloud Service and Deployment models,
1.6 Cloud adoption considerations, Cloud adoption.
1.7 Cloud History – Internet technologies (SOA, Web Services, Web 2.0, mashups), Distributed computing – Utility and Grid Computing,
1.8 Hardware – VMWareESXi, Xen, KVM; Virtual Appliances and the open Virtualization format; System Management; Anatomy of Cloud; Benefits of Cloud;
1.9 Cloud Transformation roadmap; cloud delivery models and their advantages; Cloud computing architecture.

Unit-2: IaaS, PaaS and SaaS

2.1 Introduction to Infrastructure as a Service delivery model,
2.2 characteristics of IaaS, Architecture, examples of IaaS,
2.3 Applicability of IaaS in the industry, Comparing ISPs and IaaS, Motivations for renting the infrastructure; IaaS
2.4 Case studies; IaaS enabling Technology; Trusted cloud.
2.5 Introduction to Platform as a Service delivery model, characteristics of PaaS, patterns, architecture and examples of PaaS,
2.6 Applicability of PaaS in the industry ; integrated Lifecycle Platform; Anchored Lifecycle platform; Enabling Technologies as a Platform;
2.7 PaaS – best option or not. Introduction to Software as a Service delivery model, characteristics of SaaS, SaaS Origin;
2.8 Evolvement of SaaS – Salseforce.com’s approach; SaaS Economics and Ecosystem; Types of SaaS Platforms; Architecture,
2.9 SaaS – Providers; Collaboration as a Service; Enabling and Management tools as a Service; Applicability of SaaS in the industry.

Unit-3: Cloud Computing Reference Architecture (CCRA)
3.1 Introduction to Cloud computing reference architecture (CCRA),
3.2 benefits of CCRA, Architecture overview – The conceptual Reference Model;
3.3 Cloud Consumer; Cloud provider; Cloud Auditor; Cloud carrier;
3.4 Scope of control between Provider and Consumer;
3.5 CCRA : Architectural Components – Service deployment ,
3.6 Service Orchestration, Cloud Service Management, Security;
3.7 Cloud Taxonomy; IBM's Cloud Computing Reference Architecture(CCRA 2.0) – Introduction, roles, Architectural elements;
3.8 CCRA evolution; Examples of Cloud Services; versions and application of CCRA for developing clouds.

PART-B

Unit-4: Private, Public Cloud Deployment Models
4.1 What is a Private Cloud?, Illustration of Private Cloud, Advantages of Private Cloud, Limitations of Private Cloud,
4.2 Service Management, Journey into Private Cloud,
4.3 Planning and Strategy, Standardization, Virtualization, Automation, Cloud, Case study – VMware vCloud,
4.4 Case Study – IBM SmartCloud Entry, Private cloud.
4.5 What is a Public Cloud?, Illustration of Public Cloud, Why Public Cloud, Advantages of Public Cloud, Limitations of Public Cloud,
4.6 Low degree of security and control, Lack of control on infrastructure, configuration, Network latency and accessibility concerns,
4.7 Highest long term cost, Public v/s Private, Journey into Public Cloud, Revisit the idea of adopting public cloud, Cloud vendor selection,
4.8 Migrating to Cloud, Cloud vendor selection, SLA – Service Level Agreements, Credits/Compensation terms, Credit process, Disaster recovery plan, Exclusions, Security and Privacy, Periodic upgrade and maintenance,
4.9 Data location and Jurisdiction, Pricing and Measurability, Interoperability and Lock-in, Exit process/Termination policies, Proven track record, Public cloud vendors,

Unit-5: Hybrid Cloud
5.1 Case studies. What is a Hybrid Cloud?, Why Hybrid Cloud, Illustration of Hybrid Cloud, Advantages of Hybrid Cloud, Challenges of Hybrid Cloud, Develop and manage hybrid workloads, Developing applications for hybrid cloud,
5.2 Develop applications using PaaS, Managing hybrid workloads,
5.3Journey into Hybrid Cloud, Step 1: Asses current IT infrastructure and business, Step 2: Explore cloud computing, Step 3: Create cloud deployment strategy plan, Step 4: hybrid cloud implementation.

Unit-6: Cloud Computing Platform Lab
6.1 OpenStack Introduction, OpenStack Architecture,
6.2 Lab Environment.

Text Book:
1. Cloud Computing Architecture & Deployment Models**,** IBM ICE Publication.

Software required/Weblinks:
https://www.ibm.com/developerworks/community/blogs/722f6200-f4ca-4eb3-9d64-8d2b58b2d4e8/entry/4_Types_of_Cloud_Computing_Deployment_Model_You_Need_to_Know1?lang=en

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%

Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-527)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-527.1	2	1	-	-	3	-	-	-	-	-	-	-	-	3	3
BCS-DS-527.2	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-
BCS-DS-527.3	-	-	-	3	-	-	-	-	-	-	-	3	2	-	-
BCS-DS-527.4	-	-	-	3	-	-	-	-	-	-	-	-	2	-	-
BCS-DS-527.5	-	-	-		-	-	-	-	-	-	-	-	3	-	-
BCS-DS-527.6	-	-	-	1	-	-	-	-	-	-	-	-	3	-	-

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BCS-DS-579: CLOUD COMPUTING ARCHITECTURE AND DEPLOYMENT MODELS LAB (CC)

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Cloud Computing Architecture and Deployment Models (BCS-DS-527)
Course Type: Program Core

Course Outcomes: The students will be able to-
BCS-DS-579.1 Locate the steps for open stack installation.
BCS-DS-579.2 Understand user and project management.
BCS-DS-579.3 Recognize common cloud management tasks.
BCS-DS-579.4 Enumerate the overview of Nagios and Openstacks CLI.
BCS-DS-579.5 Deploy a linux VM from an ISO image

List of Practicals:
1. Open Stack Installation
2. Familiarize with OpenStack dashboard
3. deploy a virtual machine instance
4. Deploy a Linux VM from an ISO Image
5. Deploy a VM from an image snapshot
6. User and Project management
7. Common Cloud Management tasks
8. Adding a new compute note
9. Overview of Nagios
10. Overview of Openstack CLI

Text Book:
1. Cloud Computing Architecture & Deployment Models, IBM ICE Publication.

Software required/Weblinks:
https://www.ibm.com/developerworks/community/blogs/722f6200-f4ca-4eb3-9d648d2b58b2d4e8/entry/4_Types_of_Cloud_Computing_Deployment_Model_You_Need_to_Know1?lang=en

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation of outcomes through:
- Evaluation in each practical (Files + Programs).
- Questions asked during implementation in lab
- Problem solving by application of concepts in Labs
- End Semester Practical Examination scores.
- Program execution by individual

- Evaluation on the basis of vivas conducted regularly.

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-579)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-579.1	3	3	3	1	2	-	-	-	1	-	-	1	-	2	2
BCS-DS-579.2	-	3	-	1	-	-	-	-	1	-	-	-	-	2	2
BCS-DS-579.3	-	-	3	1	2	-	-	-	1	-	-	1	-	2	2
BCS-DS-579.4	-	3	-	-	-	-	-	-	1	-	-	-	-	2	2
BCS-DS-579.5	3	-	3	-	-	-	-	-	1	-	-	1	-	2	3

SEMESTER – IV

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BCS-DS-401 : Discrete Mathematics

Periods/week Credits	Max. Marks : 200
L :3 T: 1 4.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Core

Course Outcomes: Students will be able to-

BCS-DS-401.1 Memorize basic discrete mathematical techniques widely used in Computer Science.
BCS-DS-401.2 Understand & derive solution of a given problem using mathematical induction and counting techniques.
BCS-DS-401.3 Apply logical inference to prove the solution of given problem.
BCS-DS-401.4 Discriminate different problems based on their algebraic structure.
BCS-DS-401.5 Formulate Boolean functions and by using properties of Boolean algebra can simplify the expressions.
BCS-DS-401.6 Generate solution of a given problem with graph & tree techniques.

PART- A

Unit-1: Sets, Relation and Function

1.1 Operations and Laws of Sets, Cartesian Products.
1.2 Binary Relation, Partial Ordering Relation, Equivalence Relation.
1.3 Sum and Product of Functions, Bijective functions, Inverse and Composite Function
1.4 Image of a Set, Size of a Set.
1.5 Finite and infinite Sets, Countable and uncountable Sets.
1.6 Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem.

Unit-2: Propositional Logic

2.1 Syntax, Semantics, Validity and Satisfiability.
2.2 Basic Connectives and Truth Tables.
2.3 Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers.
2.4 Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

Unit-3: Counting Techniques and Mathematical Induction

3.1 Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination.
3.2 The Well-Ordering Principle.
3.3 Mathematical Induction.
3.4 The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

PART –B

Unit-4: Recursion and Recurrence Relations

4.1 Polynomials, evaluation of polynomials, Sequences,
4.2 Partial fractions, linear recurrence relation with constant coefficients,
4.3 Homogeneous solutions, Particular solutions, Generating functions, Total solution of a recurrence relation using generating functions.

Unit-5: Algebraic Structures and Morphism

5.1 Algebraic Structures with one Binary Operation.
5.2 Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures.
5.3 Free and Cyclic Monoids and Groups, Permutation Groups, Substructures.

5.4 Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Unit-6: Graphs and Trees

6.1 Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph.
6.2 Isomorphism, Eulerian and Hamiltonian Walks.
6.3 Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring.
6.4 Perfect Graph, definition properties and Example.
6.5 Rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

Text Books/ Reference Books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
2. Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.
4. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science", TMG Edition, TataMcgraw-Hill
5. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press.
6. Seymour Lipschutz, Marc Lipson, Schaum's Outlines Series, Discrete Mathematics, Tata McGraw – Hill.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-401)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-401.1	3	2	1	2	2	3	2	1	2	2	2	3	2	2	3
BCS-DS-401.2	3	2	2	2	2	3	3	2	3	2	3	3	3	3	2
BCS-DS-401.3	2	1	2	1	2	2	1	1	3	1	3	3	3	2	2
BCS-DS-401.4	1	3	2	2	3	1	1	1	2	1	2	2	2	2	3
BCS-DS-401.5	1	1	1	3	1	2	2	1	2	1	1	2	2	3	2
BCS-DS-401.6	1	1	3	1	3	2	2	2	3	2	1	2	1	3	3

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BCS-DS -402: Computer Organization & Architecture

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Core

Course Outcomes: Students will be able to-

BCS-DS-402.1. Learn the functional block diagram of a single bus architecture of a computer

BCS-DS-402.2. Describe the function of the instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set.

BCS-DS-402.3. Demonstrate assembly language program for specified microprocessor for computing 16 bit multiplication, division and I/O device interface (ADC, Control circuit, serial port communication).

BCS-DS-402.4. Categorize & describe the process for Concurrent access to memory and cache coherency in Parallel Processors.

BCS-DS-402.5. Compare different CPU organizations and instruction and will be able to design a memory module and able to analyze its operation by interfacing with the CPU.

BCS-DS-402.6. Appraise CPU performance, and apply design techniques to enhance performance using pipelining, parallelism and RISC methodology

PART-A

Unit 1: Functional blocks of a computer

1.1 Functional blocks of a computer: CPU, memory, input-output subsystems, control unit.
1.2 Instruction set architecture of a CPU – registers, instruction execution cycle.
1.3 RTL interpretation of instructions, addressing modes, instruction set.
1.4 Case study – instruction sets of some common CPUs.

Unit 2: Data representation

2.1 Data representation: signed number representation, fixed and floating point representations, character representation.
2.2 Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc.
2.3 Division restoring and non-restoring techniques ,floating point arithmetic.

Unit 3: Microprocessor architecture, CPU control unit and Memory system design

3.1 Introduction to x86 architecture.
3.2 CPU control unit design: hardwired and micro-programmed design approaches.
3.3 Case study – design of a simple hypothetical CPU.
3.4 Memory system design: semiconductor memory technologies, memory organization.

PART-B

Unit 4: Peripheral devices and their characteristics

4.1 Peripheral devices and their characteristics: Input-output subsystems, I/O device interface
4.2 I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions.
4.3 Programs and processes – role of interrupts in process state transitions
4.4 I/O device interfaces – SCII, USB.

Unit 5: Pipelining and parallel processing

5.1 Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.
5.2 Parallel Processors: Introduction to parallel processors.
5.3 Concurrent access to memory and cache coherency.

Unit 6: Memory organization

6.1 Memory organization: Memory interleaving, concept of hierarchical memory organization
6.2 Cache memory, cache size vs. block size, mapping functions
6.3 Replacement algorithms, write policies.

Text Books/ Reference Books:

1. David A. Patterson and John L. Hennessy ,"Computer Organization and Design: The Hardware/Software Interface",5th Edition, Elsevier.
2. CarlHamache, "Computer Organization and Embedded Systems", 6th Edition, McGraw Hill Higher Education.
3. John P. Hayes "Computer Architecture and Organization", 3rd Edition, WCB/McGraw-Hill
4. William Stallings "Computer Organization and Architecture: Designing for Performance", 10th Edition, Pearson Education.
5. Vincent P. Heuring and Harry F. Jordan, "Computer System Design and Architecture",2nd Edition, Pearson Education.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-402)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PS O 1**	**PS O 2**	[illegible]
BCS-DS-402.1	2	2	2	1	-	-	-	-	-	1	-	2	-	2	[illegible]
BCS-DS-402.2	3	3	2	2	2	1	2	-	-	2	-	3	2	2	[illegible]
BCS-DS-402.3	3	3	3	2	-	-	-	1	1	-	1	2	2	2	[illegible]
BCS-DS-402.4	2	3	3	2	-	2	2	1	1	1	2	3	2	2	[illegible]
BCS-DS-402.5	3	3	2	2	1	-	2	1	2	2	2	3	2	2	[illegible]
BCS-DS-402.6	3	2	2	2	2	2	2	2	2	2	2	-	3	3	[illegible]

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BCS-DS-403: Operating Systems

Periods/week Credits — Max. Marks : 200
L :3 T: 1 4.0 — Continuous Evaluation : 100
Duration of Exam: 3 Hrs — End Sem Examination : 100

Pre-Requisites: Basic Knowledge of computers
Course Type: Program Core

Course Outcomes: Students will be able to-
BCS-DS-403.1 Define the features of UNIX and Linux operating system to conceptualize the components

involved in designing a contemporary OS

BCS-DS-403.2 Understand the concepts of process, address space, file system and system components that are used in working of operating system and Compare various CPU scheduling algorithms.

BCS-DS-403.3 Apply various inter-process communication mechanism.

BCS-DS-403.4 Analyze how deadlock exists in the system and how to recover from it.

BCS-DS-403.5 Evaluate the performance of segmented and paged memories.

BCS-DS-403.6 Develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

PART - A

Unit 1: Introduction

1.1 Concept of Operating Systems, generations of operating systems, types of operating systems, OS services, system calls.

1.2 Structure of an OS – Layered, monolithic, microkernel operating systems.

1.3 Concept of virtual machine.

1.4 Case study on UNIX and WINDOWS operating system.

Unit 2: Processes

2.1 Definition, process relationship, different states of a process, process state transitions, Process Control Block (PCB), context switching.

2.2 Thread: Definition, various states, benefits of threads, types of threads, concept of multithreads.

2.3 Process Scheduling: Foundation and scheduling objectives, types of schedulers.

2.4 Scheduling criteria: CPU utilization, throughput, turnaround time, waiting time, response time.

2.5 Scheduling algorithms: pre-emptive and non pre-emptive, FCFS, SJF, RR.

2.6 Multiprocessor scheduling: real time scheduling: RM and EDF.

Unit 3: Inter-process Communication

3.1 Critical section, race conditions, mutual exclusion.

3.2 Hardware solution, strict alternation, peterson's solution, the producer\ consumer problem.

3.3 Semaphores, event counters, monitors, message passing.

3.4 Classical IPC Problems: reader and writer problem, dining philosopher problem etc.

PART - B

Unit 4: Deadlocks

4.1 Definition, necessary and sufficient conditions for deadlock.

4.2 Deadlock prevention.

4.3 Deadlock avoidance: Banker's algorithm.

4.4 Deadlock detection and recovery.

Unit 5: Memory Management

5.1 Basic concept, logical and physical address map.

5.2 Memory allocation: Contiguous memory allocation, fixed and variable partition, internal and external fragmentation and compaction.

5.3 Paging: principle of operation, page allocation, Hardware support for paging, protection and sharing, disadvantages of paging.

5.4 Virtual Memory: Basics of virtual memory, hardware and control structures.

5.5 Locality of reference, page fault , working set , dirty page/dirty bit, demand paging.

5.6 Page replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not Recently Used (NRU) and Least Recently Used (LRU).

Unit 6: I/O Hardware

6.1 I/O devices, device controllers, direct memory access.

6.2 Principles of I/O Software: Goals of interrupt handlers, device drivers, device independent I/O software.

6.3 Secondary-storage structure: Disk structure, disk scheduling algorithms.

6.4 File Management: Concept of file, access methods, file types, file operation, directory structure, file system structure. Allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

6.5 Disk Management: Disk structure, disk scheduling - FCFS, SSTF, SCAN, C-SCAN, disk reliability, disk formatting, boot-block, bad blocks.

Text Books/ Reference Books:

1. Avi Silberschatz, Peter Galvin, Greg Gagne, Operating System Concepts Essentials, 9th Edition, Wiley Asia Student Edition.
2. William Stallings, Operating Systems: Internals and Design Principles, 5th Edition, Prentice Hall of India.

Suggested reference books:

1. Charles Crowley Operating System: A Design-oriented Approach, 1st Edition, Irwin Publishing
2. Gary J. Nutt, Operating Systems: A Modern Perspective, 2nd Edition, Addison-Wesley.
3. Maurice Bach, Design of the Unix Operating Systems, 8th Edition, Prentice-Hall of India
4. Daniel P. Bovet, Marco Cesati, Understanding the Linux Kernel, 3rd Edition, O'Reilly and Associates

Instructions for paper setting:

Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-403)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-403.1	2	2	1	3	2	2	2	1	2	2	2	3	2	2	2
BCS-DS-403.2	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2
BCS-DS-403.3	2	3	3	1	2	2	1	2	2	1	2	2	2	2	2
BCS-DS-403.4	2	1	2	2	2	-	1	1	2	2	1	1	1	2	1
BCS-DS-403.5	1	2	1	2	2	1	1	2	2	2	2	2	2	2	2
BCS-DS-403.6	1	2	2	2	1	2	2	1	3	1	1	3	2	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-404 : Database Management Systems

Periods/week Credits	Max. Marks	: 200
L :3 T: 1 4.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Core

Course Outcomes: Students will be able to-

BCS-DS-404.1. Recognize the importance of database management system, its components and architecture.

BCS-DS-404.2. Describe different data models, and conceptual E-R model, able to understand the concepts transaction processing and concurrency control.

BCS-DS-404.3. Apply essential DBMS concepts such as: information storage system, database security, integrity, concurrency.

BCS-DS-404.4. Use multiple query language techniques, write relational algebra expression and optimization of query.

BCS-DS-404.5. Evaluate database schema and its normalization.

BCS-DS-404.6. Build a simple database system and demonstrate competence with the fundamental tasks involved with modelling, designing, and implementing a DBMS.

PART- A

Unit-1: Database System Architecture

1.1 Data Abstraction, Data Independence,
1.2 Data Definition Language (DDL), Data Manipulation Language(DML),
1.3 Entity-Relation Model,
1.4 Network Model, Relational and object oriented data models,
1.5 Integrity Constraints,
1.6 Data Manipulation Operation.

Unit-2: Relational database Design, query languages and Optimization

2.1 Relational Database Design, Domain and Data Dependency, Armstrong's axioms,
2.2 Normal Forms, Dependency preservation, Lossless Design,
2.3 Relational Query Languages, Relational algebra,
2.4 Tuple and Domain Relational Calculus,
2.5 SQL, DDL, and DML constructs,
2.6 Open Source and Commercial DBMS-MYSQL, ORACLE, DB2, SQL Server,
2.7 Query Processing and Optimization, Evaluation of Relational Algebra Expression,
2.8 Query equivalence, Join Strategies, Query Optimization Algorithms.

Unit-3: Storage Strategies

3.1 Indices,
3.2 B-trees,
3.3 Hashing.

PART –B

Unit-4: Transaction Processing

4.1 Transactions, ACID properties, concurrency control,
4.2 Serializability of scheduling, Locking and timestamp based scheduler,
4.3 Multi-version and optimistic concurrency control schemes,
4.4 Database Recovery.

Unit-5: Database Security

5.1 Authentication, Authorization and access control,
5.2 DAC, MAC and RBAC models,Intrusion Detection,
5.3 SQL injection.

Unit-6: Advanced Topics

6.1 Object oriented and object relational databases,
6.2 Logical databases, Web Databases
6.3 Distributed databases, Data warehousing and Data Mining.

Text Books / Reference Books:

1. A. Silberschatz, H.F. Korth and S. Sudarshan,1997, Database System Concepts, 3rd Ed.,TMH.
2. R. Elmasri and S.B. Navathe, 2000, Fundamentals of Database Systems, 3rd Ed, AW.
3. C.J. Date, 2000, An Introduction to Database Systems, 7th ED., Addison-Wesley.
3. J.D. Ullman, Principles of Database and Knowledge-Base system: Vol.1, Computer science Press.
4. S K Singh, Database Systems: Concepts, Design and Application, Pearson.
5. Ivan Bayross, SQL, PL/SQL The Programming Language of Oracle, 2nd Ed., BPB Publication.
6. Allen and Christopher, Oracle Database 10g PL/SQL 101, 3rd edition, TMG.
7. Bipin Desai, 1991, Introduction to Database Management System, Galgotia Pub.
8. Serge Abiteboul, Richard Hull, Victor Vianu, Foundations of Databases : Reprint Addition-Wesley.

Software required/Weblinks:

MySQL/Oracle
www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-404)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BCS-DS-404.1	2	3	1	2	3	2	2	1	2	2	2	2	2	3	3
BCS-DS-404.2	3	2	2	2	2	3	3	2	3	2	3	3	2	2	3
BCS-DS-404.3	2	1	2	1	3	2	1	1	2	1	2	2	2	3	2
BCS-DS-404.4	1	2	3	3	2	1	1	1	3	1	2	2	3	2	2
BCS-DS-404.5	1	1	1	3	1	2	2	1	2	1	1	3	2	3	3
BCS-DS-404.6	1	1	3	1	3	3	3	2	3	3	1	3	1	3	3

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BCS-DS-405: Computer Networks

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of Networks
Course Type: Program Core

Course Outcomes: Students will be able to-
BCS-DS-405.1. Develop the basic concept of network & layered architechture of OSI model.
BCS-DS-405.2. Describe various LAN & WAN Standards with its protocols.
BCS-DS-405.3. Describe of data link layer with its protocols
BCS-DS-405.4. Understand various protocols like ARP, RARP and switching concepts comes under network layer.
BCS-DS-405.5. Analyse transport layer protocols UDP, TCP and various congestion control algorithms.
BCS-DS-405.6. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

PART- A

Unit 1: Foundation of Computer Networks
1.1 Data communication Components

1.2 Representation of data and its flow Networks
1.3 Various Connection Topology
1.4 Protocols and Standards : OSI model
1.5 Transmission Control Protocol (TCP/IP):Frame Format
1.6 Multiplexing - Frequency division, Time division and Wave division
1.7 Spread Spectrum Techniques.

Unit 2: LAN and WAN Technologies
2.1 LAN overview: LAN standards,
2.2 Channel access methods: CSMA, CSMA/CD, Token ring.
2.3 Ethernet: layered architecture, Fast Ethernet: layered architecture, Gigabit Ethernet (IEEE 802.3z): Format, Applications.10GB Ethernet: Overview and Specifications, Layered protocol architecture and Applications.
2.4 Wireless LAN (IEEE 802.11):, Bluetooth (IEEE 802.15): Security and applications.
2.5 Introduction to WAN, WAN technologies: SONET/SDH,
2.6 ATM: ATM cell, layered architecture, ATM signaling, addressing and applications.
2.7 Frame Relay Technology Overview and Standards.
2.8 ISDN & B-ISDN: Technology Overview, Interfaces and Channels.

Unit 3: Overview of Data Link Layer
3.1 Data Link Layer and Medium Access Sub Layer
3.2 Error Detection and Error Correction - Fundamentals,
3.3 Block coding, Hamming Distance, CRC;
3.4 Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access,
3.5 Multiple access protocols -Pure ALOHA, Slotted ALOHA

PART- B

Unit 4: Overview of Network Layer
4.1 Network Layer: Switching,
4.2 Logical addressing – IPV4, IPV6;
4.3 Address mapping – ARP, RARP, BOOTP and DHCP–Delivery,
4.4 Forwarding and Unicast Routing protocols.

Unit 5: Overview of Transport Layer
5.1 Transport Layer: Process to Process Communication,
5.2 User Datagram Protocol (UDP),
5.3 Transmission Control Protocol (TCP), SCTP
5.4 Congestion Control; Quality of Service,
5.5 QoS improving techniques: Leaky Bucket and Token Bucket algorithm

Unit 6: Overview of Application Layer
6.1 Domain Name Space (DNS), DDNS,
6.2 TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth,
6.3 Firewalls,
6.4 Basic concepts of Cryptography

Text Books/ Reference Books:

1. Behrouz A. Forouzan, Data Communication and Networking, 4th Edition, McGrawHil.
2. A. S. Tanenbaum, Computer Networks, 4th Ed., Pearson Education.
3. William Stalling, Data and Computer Communication, 8th Edition, Pearson Prentice Hall India.
4. L. Peterson and B. Davie, "Computer Networks – A Systems Approach" 5th Edition, Elsevier Morgan Kaufmann Publisher.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%

Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-405)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-405.1	2	3	1	2	3	2	2	2	2	2	2	2	2	3	3
BCS-DS-405.2	3	2	2	2	2	2	3	2	3	2	3	3	2	2	3
BCS-DS-405.3	2	1	2	1	3	3	1	1	2	1	2	2	2	3	2
BCS-DS-405.4	1	2	3	3	2	1	1	1	3	1	2	2	3	2	2
BCS-DS-405.5	1	1	1	3	1	2	2	1	2	1	1	3	2	3	3
BCS-DS-405.6	1	1	3	1	3	3	3	2	3	3	1	3	1	3	3

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BCS-DS-451: Operating Systems Lab

Periods/week	Credits	Max. Marks	: 100
P :2	1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Operating Systems (BCS-DS-403)
Course Type: Program Core

Course Outcomes: Students will be able to-
BCS-DS-451.1. State the features of Operating systems and programs, with a view to be able to implement simple systems in this model.
BCS-DS-451.2. Understand how to obtain information regarding Host, Network, Protocol, Domain, create the utility functions on system.
BCS-DS-451.3. Demonstrate the implementation of file systems and shell programming.
BCS-DS-451.4. Examine the manipulation of the I/O devices and system components.
BCS-DS-451.5. Argue how to change the content of system calls.
BCS-DS-451.6. Develop various system programs under Linux to make use of OS concepts related to process synchronization, shared memory, file systems, etc.

List of Practicals:
1. Carry out installation of windows XP /NT Operating System and Check.
2. Carry out installation of LINUX/UNIX Operating System and check.
3. Perform the handling of following:
   System Tools, storage management, services and applications in windows operating system.
4. Implement the various commands of LINUX/UNIX Operating System.
5. Perform the handling of process management & file management functions of operating

system: LINUX/UNIX.
6. Implement the file security and file sharing, redirection and UNIX Pipes.
7. Implement the Compilation process and compilation of C, C++ & Java Programs in UNIX & working with Libraries in UNIX.
8. **Shell Programming:** shell script overview & implementation.
    A. shell variables and related commands.
    B. Passing arguments to shell scripts
    C. Program for control commands
    D. Functions in shell

    Write shell scripts and implement for the following:
    a. handling (sorting, Searching)
    b. Program for file handling
    c. Program for GUI Program for Fibonacci series and factorial of a no.
    d. Program for Sum /average/ highest of a no.
    e. Program for string handling (reverse of sorting and comparing)
    f. Program for array Development.
9. Write a shell script to create 5 file with size O, filename supplied as command line argument.
10. Write a shell script to check whether the contents of two files are same or not. If contents are same delete the 2nd file.
11. Write a shell script to search a line in a file which contains given set of words (use for loop)
12. Write a shell script to check whether a character entered is a small case, digit or a special symbol. (Use case)
13. Write a shell script to count the no. of words and no. of lines in a file.
14. Write a shell script to check every 30 secs. Whether user has login. The moment user logs in, Send a greeting to him as Good morning/ Good Afternoon/Good evening depending upon the time he logs in.
15. Write a shell script for menu driven program.
    1. Add 2. Delete 3. Display 4. Edit 5. List all menu 6. Exit

16. Write a shell script to beep the speaker after every 10 minutes or after specified number of minutes.
17. WAP to design a shell.

Software required/Weblinks:
https://nptel.ac.in/courses/117/106/117106113/

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

Course Articulation Matrix:

CO Statement (BCS-DS-451)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-451.1	2	2	2	2	2	2	1	2	1	1	1	1	2	2	3
BCS-DS-451.2	2	3	2	2	2	3	1	2	1	1	1	1	2	2	2
BCS-DS-451.3	3	3	2	2	2	3	1	1	2	1	2	1	2	2	1

BCS-DS-451.4	2	2	3	2	2	2	1	3	1	1	1	2	2	2	3
BCS-DS-451.5	2	2	2	2	2	1	1	3	2	1	3	1	2	2	2
BCS-DS-451.6	2	2	2	2	2	1	1	1	1	1	1	3	2	2	2

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BCS-DS-452: DATABASE MANAGEMENT SYSTEMS LAB

Periods/week	Credits		Max. Marks	: 100
P :2	1.0		Continuous Evaluation	: 50
Duration of Exam: 2 Hrs			End Sem Examination	: 50

Co-Requisite: Database Management Systems (BCS-DS-404)
Course Type: Program Core

Course Outcomes: Students will be able to-
BCS-DS-452.1. Recognize and effectively explain the underlying concepts of database Management System.
BCS-DS-452.2. Populate and query a database using SQL DML/DDL/DCL commands.
BCS-DS-452.3. Apply different integrity constraints with respect to database using a state-of-the-art RDBMS.
BCS-DS-452.4. Evaluate database using SQL queries.
BCS-DS-452.5. Programming PL/SQL including stored procedures, stored functions.
BCS-DS-452.6. Design and implement and normalize database schema for a Given problem-domain.

List of Practicals:
1. Create a student database (Roll No., Name, Dept.) and write the queries to carry out the following operations)
   1. Add 20 new records to the database.
   1. Delete 5 records from the database.
   2. Add another column phone No. to this database.
   3. Add values to the column phone No.
   4. Change the data type of column phone No. from number to var char2.
   5. Delete a table from the database.
   6. Drop the table.
1. Write queries to display records in ascending and descending order from the student database.
2. Calculate and display the total no of students enrolled in following subjects from students database:-
   5.1. Mathematics
   5.2. Science
   5.3. English

4. Write queries to implement following functions to the student database.
    5.4. Grouping functions.
    5.5. Date and time functions.
    5.6. Mathematical functions.
    5.7. Character functions.
    5.8. Conversion functions.
2. Create a view on student database to display the data of all the students in Computer Science, Mechanical and IT departments.
3. Create an employee database and create the following two tables:
   Employee (Empid, Name Department) and accounts (Empid, Salary)
   Display the name of all Employees having salaries greater than 10,000.
4. Display the name of employees along with their respective manager name from the following table.

Empid	Emp Name	Manager
E001	Ivan	E003
E002	Bayross	E004
E003	Cristinna	E002
E004	Maria	E001

5. Write queries to implement primary key, foreign key, Not Null and Check constraints on employee database.
6. Write queries to implement database triggers on student database.
7. Create a PL/SQL procedure called QUERY_ EMP to query the employee database retrieving the salary and job title for an employee when provided with the employee number compile the code, invoke the procedure and display the salary and job title for the employee.
8. Create a PL/SQL procedure NEW_EMP to insert a new employee into the EMP_ database. The procedure should contain a call to function VALID_ DEPI to check whether the department number specified for the new employee exists in the department table.
   Test your NEW_EMP procedure by adding a new employee to the database.
9. Use a curser to retrieve the department number and department name from the dept. table: Pass the dept. no. to another curser to retrieve from the employee table the details of employee name, job and salary of all employees who is working in that department.
13. Develop two menu driven project for management of database system:
    1. Library Information System
        (a) Engineering Courses
        (b) MCA Course
    2. Inventory Control System
        (c) Computer Lab
        (d) College Store
    3. Student Information System
        (e) Academic Section
        (f) Finance Department
    4. Time Table Development System
        (g) CSE, IT and MCA Departments
        (h) Electrical and Mechanical Departments
        (i)

Text Books / Reference Books:

1. Ivan Bayross, 2007, SQL, PL/SQL The Programming Language of Oracle, 2nd Ed., BPB Publication.
2. Allen and Christopher, 2015, Oracle Database 10g PL/SQL 101, 3rd edition, TMG.

Software required/Weblinks:

MYSQL, Microsoft SQL SERVER
www.w3schools.com/sql
www.tutorialspoint.com/sql
Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%

Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-452)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-452.1	2	2	1	2	3	2	2	1	2	2	2	3	2	2	2
BCS-DS-452.2	3	2	2	2	2	2	3	2	2	3	3	3	2	2	2
BCS-DS-452.3	2	1	2	1	3	3	1	1	2	1	2	2	2	2	2
BCS-DS-452.4	1	3	2	3	3	1	1	1	2	1	3	3	2	2	2
BCS-DS-452.5	1	1	1	3	1	2	3	1	3	1	1	3	2	2	3
BCS-DS-452.6	1	1	3	1	3	3	3	2	3	3	1	3	1	3	3

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BCS-DS-453: COMPUTER NETWORKS LAB

Periods/week Credits	Max. Marks	: 100
P :2 1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs	End Sem Examination	: 50

Co-Requisite: Computer Networks (BCS-DS-405)
Course Type: Program Core

Course Outcomes: Students will be able to-
BCS-DS-453.1. Describe the features of forming a network using switch & router .
BCS-DS-453.2. Understand the concept of Packet Tracer software..
BCS-DS-453.3. Simulate the processes of NS3.
BCS-DS-453.4. Install & configure process.
BCS-DS-453.5. Introduce proxy server & learning concepts of C language
BCS-DS-453.6. Design a network using Wire Shark .

List of Practicals:
1. Identify different kinds of cables and connect two computers without any switch /with switch.
2. Design a network with the help of CISCO packet Tracer which involves a switch /hub.
3. Design a network with the help of router/without router on CISCO Packet Tracer.
4. Install a print server in LAN.
5. Write a program in NS3 to connect two to three nodes.
6. Write a program in NS3 to implement star ,bus ,hub & hierarchical topology .
7. Write a program in NS3 for connecting multiple routers &nodes &building a hybrid topology & then calculating network performance.
8. Analyze the network traces using Wire Shark Software .
9. Configure a proxy server for network.
10. Make a client server using C to transfer files from one host to another host.
11. Perform an initial configuration of a Cisco Catalyst 2960 switch using packet tracer
12. Performing an Initial Router Configuration using packet tracer(Configure the router host name, Configure passwords,Configure banner messages & Verify the router configuration)

Text Books / Reference Books:

1. A. S. Tanenbaum, Computer Networks, 4th Ed., Pearson Education.
2. William Stallings, Data and Computer Communication, 8th Edition, Pearson Prentice Hall India.
3. L. Peterson and B. Davie, "Computer Networks – A Systems Approach",5th Edition, Elsevier Morgan Kaufmann Publisher.

Software required/Weblinks:

NS3, CISCO Packet Tracer, Wire shark Software , C-Language
www.tutorialspoint.com

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-453)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-453.1	1	2	1	2	3	2	2	1	2	2	2	3	2	2	2
BCS-DS-453.2	3	1	2	2	2	2	3	2	2	3	3	3	1	2	3
BCS-DS-453.3	3	1	2	1	3	3	1	1	2	1	2	2	2	2	2
BCS-DS-453.4	1	2	2	3	3	1	1	1	2	1	3	3	1	3	2
BCS-DS-453.5	1	1	1	3	1	2	3	1	3	1	1	3	2	2	3
BCS-DS-453.6	1	1	3	1	3	3	3	2	3	3	1	3	1	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

NAAC 'A' Grade University

DTI- 400: Design, Thinking and Innovation-II

Periods/week	Credits	Max. Marks	: 50
L:0 T:1 P:0	1	Continuous Assessment	: 50

Pre-requisites: Design, Thinking and Innovation-I (DTI-300)
Course Type: HSMC

Course Outcomes:

DTI 400.1. To understand the research methodologies/approaches/techniques used in the literature
DTI 400.2. To formulate the experimental procedures / algorithms based on research methodology
DTI 400.3. To develop prototype by experiment / simulation.
DTI 400.4. To analyze the recorded data / output.

Activity 1: Methodology Study & Matrix design.

1.1. Analysis of different approach/methodology adopted by various researchers
1.2. Comparative analysis
1.3. Prospective Design.

Activity 2: Design of experiments

2.1 Finalization of experimental procedure / algorithm design.
2.2 Procurement of materials / Hardware and Software.
2.3. Develop experimental setup / design

Activity 3: Execution of experiments/simulations

3.1. Conduct experiments/ build prototype.
3.2. Modification of the experimental set-up / algorithm.

Activity 4:

4.1 Tabulating and analyzing data / output.
4.2 Assessment of the output with earlier published work / product
4.3 Interpretation and presentation of the results / outcome.

Course Articulation Matrix:

CO Statement (XX-400)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
DTI-400.1	3	-	-	2	3	3	-	2	1	-	-	-	1	-
DTI -400.2	3	3	-	3	3	2	1	3	2	-	3	1	3	2
DTI -400.3	3	-	2	2	2	-	3	3	3	3	3	2	3	3
DTI -400.4	3	3	2	1	2	2	2	-	2	2	2	2	3	2

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No.	Parameters	Description	
1.	**Attendance**	• Percentage of classes attended by the students	**5**
2.	**Continuous Performance**	Group participation and response of the students to a given task: • Judge individual student in the group • Meeting timelines as per lesson plan	**15**
3.	**Experimental Setup / Design**	• Assessment of experimental set up / design • Evaluation of result / outcome. • Validation of results. • Novelty / Relevance of work.	**20**
4.	**Structuring and presentation**	• Structuring and presentation • Group presentation with individual contribution	**10**

References:

1. http://www.sciencedirect.com/
2. https://www.ncbi.nlm.nih.gov/pubmed
3. https://www.elsevier.com/books-and-journals
4. https://www.plos.org/
5. https://www.deepdyve.com/
6. http://ieeexplore.ieee.org/Xplore/home.jsp
7. https://www.researchgate.net/
8. https://www.science.gov/
9. https://scholar.google.co.in/
10. http://www.popsci.com/

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NAAC 'A' Grade University

BHM-320: UNIVERSAL HUMAN VALUES

Periods/week Credits	Max. Marks	: 100
L: 1 T: 1 2	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs	End Term Examination	: 50

Pre-requisite: None
Course Type: Humanities & Social Science (HSMC)

Course Outcomes: The course will enable the student to-
BHM-320.1. Develop a holistic perspective based on self-exploration aboutthemselves(humanbeing), family,societyandnature/existence.
BHM-320.2. Understand harmony in the human being,family,society and nature/existence
BHM-320.3. Strengthen the self-reflection, develop commitment and courage to act.

Unit 1: Course Introduction - Need, Basic Guidelines, Content and Process for ValueEducation(5 Lectures)
Purpose and motivation for the course,Self-Exploration–what is it? - Its content and process; 'Natural Acceptance'andExperiential Validation- astheprocessforself-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Rightunderstanding,RelationshipandPhysicalFacility- thebasic requirements for fulfillment of aspirations of every human being with their correctpriority, Understanding Happiness and Prosperity correctly- A critical appraisal of thecurrentscenario, Method to fulfill the above human aspirations: understanding and living inharmonyat variouslevels.

Unit2:UnderstandingHarmonyintheHumanBeing-HarmonyinMyself!(5 Lectures)
Understanding human being as a co-existence of the sentient 'I' and thematerial'Body' , Understanding the needs of Self ('I') and 'Body' - happiness and physicalfacility, Understanding the Body as an instrument of 'I' (I being the doer, seer andenjoyer),Understandingthecharacteristicsandactivitiesof 'I'andharmonyin'I', Understanding the harmony of I with the Body: Sanyam and Health; correctappraisalofPhysicalneeds,meaning ofProsperityindetail, ProgramstoensureSanyamandHealth.

Unit 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship(7 Lectures)

Understanding values in human-human relationship; meaning of Justice (nineuniversal values in relationships) and program for its fulfillment to ensure mutualhappiness;TrustandRespectasthefoundationalvaluesofrelationship, Understanding the meaning of Trust; Difference between intention andcompetence, Understanding the meaning of Respect, Difference between respect anddifferentiation;theother salient values inrelationship
Understanding the harmony in the society (society being an extension offamily): Resolution, Prosperity, fearlessness (trust) and co-existence ascomprehensive Human Goals,Visualizing a universal harmonious order in society- Undivided Society,Universal Order-from familyto worldfamily.

Unit 4: Understanding Harmony in the Nature and Existence - Whole existence asCoexistence(6 Lectures)

UnderstandingtheharmonyintheNature, Interconnectedness and mutual fulfillment among the four orders of nature-recyclabilityand self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space Holisticperceptionofharmonyatalllevelsofexistence.
Include practice sessions to discuss human being as cause of imbalance innature (film "Home" can be used), pollution, depletion of resources and role oftechnology etc.

Unit 5: Implications of the above Holistic Understanding of Harmony onProfessionalEthics(5 Lectures)

Naturalacceptanceofhumanvalues, DefinitivenessofEthicalHumanConduct, Basis for Humanistic Education, Humanistic Constitution and HumanisticUniversal Order, Competence in professional ethics, Case studies of typical holistic technologies, management models andproductionsystems, Strategy for transition from the present state to Universal Human Order: a. Atthe level of individual: as socially and ecologically responsible engineers,technologists and managers b. At the level of society: as mutually enrichinginstitutionsand organizations,

Text and ReferenceBooks

1. R R Gaur, R Sangal, G P Bagaria, 2010, Human Values and Professional Ethics,Excel Books, New Delhi
2. A.N. Tripathi, 2019, Human Values, New age International Publishers.
3. E G Seebauer& Robert L.Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.

Note:

Lecture's hours are to be used for interactive discussion, placing the proposalsabout the topics at hand and motivating students to reflect, explore and verifythem.

Tutorialhoursaretobeusedforpracticesessions.

Evaluation Tools:
Assessment by faculty mentor: 10 marksSelf-assessment:10marks

Assessmentbypeers:10marks

Socially relevant project/Group Activities/Assignments: 20 marks

SemesterEndExamination: 50 marks

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
BHM-320.1	-	-	2	-	-	3	1	3	2	-	-	2
BHM-320.2	-	-	2	-	-	3	1	3	2	-	-	2
BHM-320.3	-	-	2	-	-	3	1	3	2	-	-	2

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BHM-MC-006: Quantitative Aptitude and Personality Development-I

Periods/week Credits
P :2 0
Duration of Exam: 2 Hrs

Max. Marks : 100
Continuous Evaluation : 50
End Sem Examination : 50

Pre-Requisite: Basic Knowledge of English
Course Type: HSMC

Course Outcomes: Students will be able to-
BHM-MC-006.1. Recognize & solve problems based on non-verbal reasoning.
BHM-MC-006.2. Solve complex problems based on arithmetic reasoning.
BHM-MC-006.3. Apply short tricks on complex problems of verbal reasoning.
BHM-MC-006.4. Apply correct usage of grammar in communication.
BHM-MC-006.5. Enhance their vocabulary and use it in day to day life.
BHM-MC-006.6. Develop speed reading & writing skills.

PART – A

Unit 1: Arithmetic II
- 1.1 Percentages
- 1.2 Ratio & Proportion
  - 1.2.1. Proportionality
  - 1.2.2. Variations
  - 1.2.3 Partnership
- 1.3 Profit & Loss
  - 1.3.1. Basic terminology & Formulae
  - 1.3.2. Error in Weights
  - 1.3.3. Marked Price and Discounts
  - 1.4Time & Work
    - 1.4.1. Time and Work, Chain Rule
    - 1.4.1. Work & Wages
    - 1.4.2. Pipes & Cisterns
- 1.5 Mixtures & Alligations

Unit 2: Verbal Reasoning 2
- 2.1 Syllogism
- 2.2 Ranking
- 2.3 Coding-Decoding
- 2.4 Inequalities and Mathematical Operations

Unit 3: Non Verbal Reasoning

3.1 Pictorial Series
3.2 Missing Values
3.3 Analogy and Images

Part B

Unit 4: Communication Accuracy
4.1 Relevance of Verbal Ability and preparatory guidelines
4.2 Functional Grammar – Subject Verb Agreement
4.3 Tenses – Perfect, Simple, Continuous
4.4 Common Errors and rectification

Unit 5: Word Power Building Skills
5.1 Words: Antonyms, Synonyms, Verbal Analogies
5.2 Compound words: Homophones, Homonyms, Word Families
5.3 Root Word Technique for Prefixes & Suffixes
5.4: Word Power: 7 Tips for Learning New Words
5.5 Practice Vocabulary Exercises

Unit 6: Reading & Writing Skills
6.1 Objectives of Reading, Definition & Types of Reading & Importance of Reading
6.2 Reading Techniques: SW3R, Active Reading, Detailed, Speed
6.3 Practice Exercises: Short & Medium Passages3.1 Writing: Introduction of Writing Skills, Objectives of enhancing Writing Skills & Types of Writing
6.4 Sentences, Phrases, Types of Sentences, Parts of Sentences
6.5 Paragraph Writing: Construction, Linkage & Cohesion

Text Books/Reference Books:

1. R S Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations, S Chand & Company PvtLtd.
2. R S Aggarwal, 2018, A Modern Approach to Verbal& Non Verbal Reasoning, S Chand & Company Pvt Ltd.
3. Verbal Ability and Reading Comprehension: MVN Enterprises
4. P.A. Anand, Verbal Ability and Reasoning for Competitive Examinations, Wiley

Instructions for paper setting: Fifty MCQ will be set in total. Twenty five MCQ will be set from Part A and twenty five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix:

CO Statement (BHM-MC-006)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BHM-MC-006.1	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1
BHM-MC-006.2	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-
BHM-MC-006.3	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1
BHM-MC-	1	-	-	1	-	-	-	-	1	3	-	2	1	1	1

006.4															
BHM-MC-006.5	1	-	-	1	-	1	-	-	1	3	-	2	-	-	1
BHM-MC-006.6	1	2	-	1	1	1	1	1	1	3	1	2	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-406: INTRODUCTION TO VIRTUALIZATION AND CLOUD COMPUTING (CC)

Periods/week Credits Max. Marks : 200
L :2 T: 0 2.0 Continuous Evaluation : 100
Duration of Exam: 3 Hrs End Sem Examination : 100

Pre-Requisites: Nil
Course Type: Program Electives

Course Outcomes: The students will be able to-
BCS-DS-406.1. Understand Cloud computing along with Virtualization concepts and implementation
BCS-DS-406.2. Explain Cloud implementation/ cloud deployment.
BCS-DS-406.3. Use transition tools for visualisation models.
BCS-DS-406.4. Identify cloud workload and workload most suitable for cloud.
BCS-DS-406.5. Describe working of hypervisor.
BCS-DS-406.6. Illustrate virtual machines on various operating systems.

PART- A

Unit-1: Introduction to Virtualization
1.1. Traditional IT Infrastructure,
1.2. Benefits of Virtualization,
1.3. Types of Virtualization,
1.4. History of Virtualization.

Unit-2: Server & Storage Virtualization
2.1. Types of Server Virtualization,
2.2. Hypervisors,
2.3. Anatomy of Server Virtualization,
2.4. Benefits of Storage Virtualization,
2.5. Types of Storage Virtualization.

Unit-3: Network and Application Virtualization
3.1. Virtual Private Network,
3.2. Virtual-LAN,
3.3. Application portability,
3.4. Benefits of Application Virtualization.

PART –B

Unit-4: Introduction to Cloud Computing

4.1. History, Importance of Virtualization in Cloud,
4.2. Anatomy of Cloud,
4.3. Cloud deployment models,
4.4. Cloud delivery models,
4.5. stepping stones for the development of cloud,
4.6. Grid Computing,
4.7. Cloud Computing.

Unit-5: Cloud Implementations / Cloud Deployment Models, Cloud Delivery Models
5.1. Decision Factors for Cloud Implementations,
5.2. Public, Private and Hybrid Cloud, Overview,
5.3. Infrastructure as a Service (IaaS) Cloud Delivery Model,
5.4. Platform as a Service (PaaS) Cloud Delivery Model,
5.5. Software as a Service (SaaS) Cloud Delivery Model.

Unit-6: Case Study On Virtualization, Cloud Workloads
6.1. Customer IT Landscape,
6.2. Triggers of Virtualization,
6.3. Preparation for Virtualization,
6.4. Transition Tools for Virtualization, Cost savings ,
6.5. Cloud workload Overview, Workloads most suitable for Cloud,
6.6. Workloads not suitable for Cloud.

Text Books / Reference Books:
4. Introduction to Virtualization and Cloud Computing, IBM ICE Publication.

Software required/Weblinks:
www.vmware.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	20%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-406)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-406.1	3	2	-	-	-	-	-	-	-	-	-	2	-	-	-
BCS-DS-406.2	2	-	3	-	3	-	-	-	2	-	-	-	-	-	3
BCS-DS-406.3	2	-	-	-	3	-	-	-	-	-	-	-	2	2	2
BCS-DS-406.4	3	-	-	-	-	1	-	-	3	-	-	-	-	-	3
BCS-DS-406.5	2	-	-	-	3	-	-	-	-	-	-	-	3	2	3
BCS-DS-406.6	2	-	-	-	3	-	-	-	-	-	-	2	3	3	3

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BCS-DS-454: VIRTUALIZATION LAB (CC)

Periods/week	Credits	Max. Marks	:	100
P: 2	1.0	Continuous Evaluation	:	50
Duration of Examination: 2 Hrs		End Sem Examination	:	50

Co-Requisite: Introduction to Virtualization and Cloud Computing (BCS-DS-406)
Course Type: Program Core

Course Outcomes: Students will be able to-
BCS-DS-454.1. Install of various operating systems.
BCS-DS-454.2. Understand installation of virtual machines on different platforms.
BCS-DS-454.3. Illustrate VM instances and their applications.
BCS-DS-454.4. Explore advanced networking concepts.
BCS-DS-454.5. Explain virtualization in detail.
BCS-DS-454.6. Acquire knowledge and overview about cloud environment.

List of Experiments:-
1. Virtual Machine Using VMware
2. Virtual Machine Using QEMU
3. KVM on Ubuntu 12.10
4. KVM and guest operating system on CentOS6.3
5. Virtual Machine Using Hyper-V
6. Installation of Dockers in Windows/Linux
7. Creation of Instance in AWS.

Text Books / Reference Books:
1. Introduction to Virtualization and Cloud computing, IBM ICE Publication

Software required/Weblinks:
www.VMware.com
Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%

Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-454)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BCS-DS-454A.1	3	-	3	-	2	-	-	-	1	-	-	-	2	2	-
BCS-DS-454A.2	3	2	3	-	3	-	-	-	-	-	-	2	2	2	2
BCS-DS-454A.3	2	1	-	3	3	-	-	-	1	-	-	-	-	3	3
BCS-DS-454A.4	3	-	-	-	3	2	-	2	1	-	-	3	-	-	-
BCS-DS-454A.5	3	3	3	-	2	-	3	3	3	-	3	3	3	3	-
BCS-DS-454A.6	-	-	-	-	-	3	-	-	2	-	-	3	-	-	-

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BCS-DS-422:Open Source Software

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: The students will be able to-
BCS-DS-422.1. Remember Open Source software, types of OSS, history, tools etc.
BCS-DS-422.2. Understand Open Source Licensing, its types, IPR, Copyright etc.
BCS-DS-422.3. Illustrate the architecture of linux, various linux distributions available, various linux commands, booting, installation.
BCS-DS-422.4. Classify various open source web browsers and graphical user interface.
BCS-DS-422.5. Analyze Networking Commands and various types of servers
BCS-DS-422.6. Develop understanding on open source and open source communities.

PART- A

Unit-1: Introduction to Open Source Software
1.1 Introduction to Open Source Software (OSS)
1.2 History, evolution and benefits of Open Source
1.3 Types of OSS, Open Source Software vs Closed Source Software
1.4 Open Source tools
1.5 Open Source Software examples: The Origins
1.6 Advantages of Open Source Software
1.7 Open Source Challenges
1.8 Open Source Development Model-Overview, its benefits

Unit-2: Open Source Licensing
2.1 Licensing- Overview, types of Licensing
2.2 Types of Open Source Licensing, Commercial license vs Open Source License
2.3 Open Source Licensing Strategies, IPR, Copyright vsCopyleft

2.4 Copyright law, its issues, contracts, Patents
2.5 GNU-GPL, Apache license, License Review Process

Unit-3: Linux (Open Source Operating System)
3.1 Overview of Linux operating System, Linux Vs Unix
3.2 Architecture, Essential Linux Commands (Internal and External Commands)
3.3 Various Linux distributions available, Working with the System, Shells and Utilities
3.4 Booting, Installation, LILO, GRUB, Run levels
3.5 Stopping the System- Shutdown (reboot, halt)

PART- B

Unit-4: Open Source Web browsers and GUI
4.1 Open Source Web Browser- Overview, Examples
4.2 Case Study- Mozilla Firefox
4.3 The Graphical User Interface KDE, GNOME
4.4 Google chrome vs Mozilla Firefox

Unit-5: Network and Security administration in open source
5.1 Networking Commands, Apache Web Servers
5.2 DNS servers, DHCP servers, mail servers, FTP Servers.
5.3 Securing servers with Iptables, SSL
5.4 Working with the GNU Privacy guard

Unit-6: Open Source adoption and communities
6.1 Open Source Initiative (OSI), Open Source Definition
6.2 Brook’s law, Open Source Community
6.3 ASF, FSF
6.4 Drivers for adoption of Open Source
6.5 Examples of Open Source Adoption in the world

Text Books /Reference Books:
1. Sobell, 2010, Practical Guide to Linux Commands, Editors, and Shell Programming, 2nd Edition, Pearson.
2. Sumitabha Das, 2008, UNIX: Concepts and Applications, 4th Edition, McGraw-Hill.

Weblinks:
https://opensource.org/
http://aaaea.org/Al-muhandes/2008/February/open_src_dev_model.htm
https://www.diffen.com/difference/Firefox_vs_Google_Chrome
https://fossbytes.com/open-sources-license-type/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-422)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-422.1	-	-	-	-	-	3	3	3	-	2	-	3	-	-	1
BCS-DS-422.2	-	-	-	3	3	3	3	-	-	-	-	2	1	-	3
BCS-DS-422.3	-	3	-	3	2	1	2	3	-	1	-	3	-	2	3
BCS-DS-422.4	2	-	-	-	3	3	-	1	-	1	-	3	-	-	1
BCS-DS-422.5	3	2	2	2	1	2	3	2	3	3	2	3	2	3	2
BCS-DS-422.6	-	3	-	3	2	1	2	3	-	1	-	2	-	2	2

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BCS-DS-423: Cloud Computing

Periods/week Credits	Max. Marks : 200
L :3 T: 0 3.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-423.1. Define the basic of cloud computing.
BCS-DS-423.2. Understand IaaS, PaaS and SaaS service model.
BCS-DS-423.3. Apply their knowledge to implement and execute virtualization.
BCS-DS-423.4. Differentiate between different deployment models.
BCS-DS-423.5. Evaluate the services provides by different cloud models.
BCS-DS-423.6. Create their own cloud based on various models.

PART-A

Unit-1: Overview of Cloud Computing
1.1 Introduction; Overview of Cloud Computing; Cloud Service models and Cloud Deployment Models
1.2 Cloud History – Internet technologies (SOA, Web Services, Web 2.0, mashups)
1.3 Distributed computing – Utility and Grid Computing, Hardware – VMWare ESXi, Xen, KVM
1.4 Virtual Appliances and the open Virtualization format
1.5 System Management; Anatomy of Cloud; Benefits of Cloud

Unit-2: Cloud Computing Service Models
2.1. Introduction to Infrastructure as a Service delivery model, characteristics of IaaS, examples of IaaS
2.2. Introduction to Platform as a Service delivery model, characteristics of PaaS
2.3. Introduction to Software as a Service delivery model, characteristics of SaaS, SaaS Origin
2.4. Architecture of IaaS, PaaS and SaaS
2.5. Applicability of IaaS, PaaS and SaaS in the industry

Unit-3: Cloud Computing Reference Architecture (CCRA)
3.1. Introduction to Cloud computing reference architecture (CCRA), benefits of CCRA
3.2. CCRA : Architectural Components – Service deployment , Service Orchestration
3.3. Architecture overview – The conceptual Reference Model
3.4. Cloud Consumer; Cloud provider; Cloud Auditor
3.5. Cloud carrier; Scope of control between Provider and Consumer

PART B

Unit-4: Introduction to Virtualization
4.1. Traditional IT Infrastructure
4.2. Benefits of Virtualization
4.3. Types of Virtualization
4.4. History of Virtualization
4.5. Types of Server Virtualization
4.6. Hypervisors
4.7. Anatomy of Server Virtualization
4.8. Benefits of Storage Virtualization
4.9. Types of Storage Virtualization

Unit-5: Cloud Deployment Model-I
5.1. What is a Private Cloud?, Illustration of Private Cloud, Advantages of Private Cloud,
5.2. Limitations of Private Cloud, Service Management, Journey into Private Cloud,
5.3. What is a Public Cloud?, Illustration of Public Cloud, Why Public Cloud,
5.4. Advantages of Public Cloud, Limitations of Public Cloud
5.5. Public v/s Private

Unit-6: Cloud Deployment Model-II
6.1 What is a Hybrid Cloud?, Why Hybrid Cloud, Illustration of Hybrid Cloud,
6.2. Advantages of Hybrid Cloud, Challenges of Hybrid Cloud, Develop and manage hybrid workloads,
6.3. Developing applications for hybrid cloud, Develop applications using PaaS,
6.4. Managing hybrid workloads,
6.5. Journey into Hybrid Cloud, Step 1: Asses current IT infrastructure and business, Step 2: Explore cloud computing, Step 3: Create cloud deployment strategy plan, Step 4: hybrid cloud implementation.

Text Books and Reference URLs :
1. Thomas Erl, Cloud Computing: Concepts, Technology & Architecture, Pearson Publication.
2. Barrie Sosinsky, Cloud Computing Bible, John Wiley & Sons.
3. Kamal Kant Hiran, Ruchi Doshi, Temitayo Fagbola, Mehul Mahrishi Cloud Computing: Master the Concepts, Architecture and Applications with real world examples and case studies, BPB Publications.

Software Required/Weblinks
https://www.w3schools.in › Cloud Computing
https://www.ibm.com/developerworks/connect/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests

Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-423)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-423.1	1	1	2	2	2	1	3	1	1	2	1	2	1	1	1
BCS-DS-423.2	1	1	2	2	1	1	2	1	1	2	1	2	1	1	1
BCS-DS-423.3	1	1	1	1	1	1	1	1	1	2	1	2	2	3	2
BCS-DS-423.4	1	1	1	1	1	1	1	1	1	2	1	1	1	2	2
BCS-DS-423.5	1	1	2	1	1	1	2	1	1	1	1	1	1	1	2
BCS-DS-423.6	1	1	1	1	1	1	2	1	2	2	1	1	1	1	2

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BCS-DS-475: Cloud Computing Lab

Periods/week Credits	Max. Marks	: 100
P :2 1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs	End Sem Examination	: 50

Co-Requisite: Cloud Computing (BCS-DS-423)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-475.1. State and repeat installation of virtual machines on different platforms.
BCS-DS-475.2. Understand, how to create Network Topology on Cloud.
BCS-DS-475.3. Demonstrate the process of virtualization.
BCS-DS-475.4. Experiment on open Community using OpenStack.
BCS-DS-475.5. Evaluate the roles given to users working on a same project.
BCS-DS-475.6. Create their own cloud using OpenStack.

List of Experiments:-
1. Installation of VMWare
2. Virtual Machine Using VMware
3. KVM and guest operating system on CentOS6.3
4. Open Stack Installation
5. Familiarize with OpenStack dashboard
6. Trouble shooting in Virtual Machine
7. User and Project management
8. Common Cloud Management tasks
9. Overview of Openstack CLI
10. Overview of Nagios

Software required/Weblinks:
www.VMware.com
https://www.openstack.org/

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-475)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-475.1	2	1	3	1	2	1	1	1	1	1	1	1	2	2	1
BCS-DS-475.2	3	2	3	1	3	1	1	1	1	1	2	2	2	2	2
BCS-DS-475.3	2	1	1	2	3	1	1	1	1	1	1	1	1	2	2
BCS-DS-475.4	3	2	3	1	1	1	1	1	2	1	2	1	1	1	1
BCS-DS-475.5	3	2	3	1	2	1	1	1	2	1	3	1	3	3	1
BCS-DS-475.6	1	1	1	1	1	2	1	1	2	1	2	1	1	2	2

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BCS-DS-427A: Python

Periods/week Credits	Max. Marks : 200
L :2 T: 0 2.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers & Object Oriented Programming (BCS-DS-302A)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-427A.1. Understand the basic concepts of Python programming such as data types, tuples, Lists, dicts, basic operators, and functions
BCS-DS-427A.2. Demonstrate knowledge with the Python Program Development Environment (PPDE).
BCS-DS-427A.3. Describe the principles of object-oriented programming using Python
BCS-DS-427A.4. Perform high-level mathematical computing using the NumPy package and library of Mathematical Functions
BCS-DS-427A.5. Solve problems requiring the writing of well-documented programs in the Python language, including use of the logical constructs.
BCS-DS-427A.6. Design, code, and test Python programs on some mini projects

PART-A

UNIT-1: Parts of Python Programming Language

1.1 Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity,
1.2 Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language,
1.3 **Control Flow Statements,** The if Decision Control Flow Statement, The if…else Decision Control Flow Statement, The if…elif…else Decision Control Statement, Nested if Statement,
1.4 The while Loop, The for Loop, The continue and break Statements,
1.5 Built-In Functions, Commonly Used Modules,
1.6 Function Definition and Calling the Function, The return Statement and void Function,
1.7 Scope and Lifetime of Variables, Default Parameters,

UNIT-2: Strings, List Methods & exception

2.1 Creating and Storing Strings, Basic String Operations,
2.2 Accessing Characters in String by Index Number, String Slicing and Joining,
2.3 String Methods, Formatting Strings,
2.4 Lists, Creating Lists, Basic List Operations, Indexing and Slicing in Lists,
2.5 Built-In Functions Used on Lists, List Methods, The del Statement.
2.6 The anatomy of exception
2.7 Python Built-in Exceptions

UNIT-3: Python Data Structures
3.1 Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries,
3.2 Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement,
3.3 **Tuples and Sets,** Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples,
3.4 Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries
3.5 Tuple Methods, Using zip() Function, Sets, Set Methods, Traversing of Sets, Frozenset

PART-B

UNIT-4: Working with NumPy:
4.1 Creating NumPy arrays
4.2 Indexing and slicing in NumPy
4.3 Downloading and parsing data
4.4 Creating multidimensional arrays
4.5 NumPy Data types
4.6 Array tributes
4.7 Indexing and Slicing
4.8 Creating array views copies
4.9 Manipulating array shapes I/O

UNIT-5: Files Handling
5.1 Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files,
5.2 The Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules,
5.3 **Regular Expression Operations,** Using Special Characters, Regular Expression Methods,
5.4 Named Groups in Python Regular Expressions, Regular Expression with glob Module.

UNIT-6: Object-Oriented Programming
6.1. Classes and Objects, Creating Classes in Python, Creating Objects in Python,
6.2. The Constructor Method, Classes with Multiple Objects,
6.3. Class Attributes versus Data Attributes, Encapsulation,
6.4. Inheritance, The Polymorphism

Text Books / Reference Books:

1. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor Francis, 2018. ISBN-13: 978-0815394372.
2. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", 1st Edition, O'Reilly Media, 2016. ISBN-13: 978-1491912058.
3. AurelienGeron, Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition,O'Reilly Media, 2017. ISBN – 13: 978-1491962299.
4. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365.
5. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", 2nd Edition, O'Reilly Media, 2018. ISBN-13: 978-1491991732.

Software required/Weblinks:
https://www.python.org
https://www.coursera.org/python
https://www.edx.org/python

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-427A)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
BCS-DS-427A.1	3	3	2	3	1	2	1	1	1	1	1	3	3	3	3
BCS-DS-427A.2	3	3	2	2	2	2	1	1	1	1	1	3	3	3	3
BCS-DS-427A.3	3	3	3	2	2	1	1	1	1	1	1	3	3	3	3
BCS-DS-427A.4	3	3	3	1	1	2	1	1	3	1	1	3	3	3	3
BCS-DS-427A.5	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3

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BCS-DS-479A: Python Lab

Periods/week Credits	Max. Marks	: 100
P: 2 1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs	End Sem Examination	: 50

Co-Requisite: Python (BCS-DS-427A)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-479A.1. To understand the basic concepts of Python programming such as data types, tuples, Lists, dicts, basic operators, and functions
BCS-DS-479A.2. To demonstrate knowledge with the Python Program Development Environment (PPDE).
BCS-DS-479A.3 To Describe the principles of object-oriented programming using Python
BCS-DS-479A.4. To perform high-level mathematical computing using the NumPy package and library of Mathematical Functions
BCS-DS-479A.5. Solve problems requiring the writing of well-documented programs in the Python language, including use of the logical constructs.
BCS-DS-479A.6. To Design, code, and test Python programs on some mini projects

List of experiments-
1. Write a Python program which accepts the radius of a circle from the user and compute the area.
2. Write a Python program to get the volume of a sphere with radius 6.
3. Write a Python program to find whether a given number (accept from the user) is even or odd, print out an appropriate message to the user.
4. Write a Python program to get the least common multiple (LCM) of two positive integers.
5. Write a Python program to create all possible strings by using 'a', 'e', 'i', 'o', 'u'. Use the characters exactly once.
6. Write a Python program to solve the quadratic equation.
7. Write a Python program to convert Celsius to Fahrenheit.
8. Write a Python program to find factorial of a Number.
9. Write a Python program to find the resolution of JPEG image.
10. Write a Python Program to generate Random Numbers.
11. Write a Python Program to find ASCII value of character present in a string.
12. Write a Python Program to find largest element in an array.
13. Write a Python Program to check if a given array is Monotonic or not.
14. Write a Python Program to find the length of the list.
15. Write a Python Program to reverse the given list.
16. Write a Python Program to count positive and negative numbers in a list.

17. Write a Python Program to check if a string is palindrome or not.
18. Write a Python Program to split and join a string.
19. Write a Python Program to sort Python Dictionary by Key or Value.
20. Write a Python Program to sort list of dictionaries by values using lambda function.
21. Write a Python Program to create grade calculator.
22. Write a Python Program using dictionary to find mirror characters in a string.
23. Write a NumPy program to test whether none of the elements of a given array is zero.
24. Write a NumPy program to test element-wise for positive or negative infinity.
25. Write a NumPy program to create an array of 10 zeros,10 ones, 10 fives.
26. Write a NumPy program to create an array of all the even integers from 30 to 70
27. Write a NumPy program to compute sum of all elements, sum of each column and sum of each row of a given array
28. Write a Python Program to print double sided stair-case pattern.
29. Write a Python Program for Binary Search(Recursive and Iterative) algorithm.
30. Write a Python Program for Bubble Sort.
31. Write a Python Program to convert time from 12 hour to 24 hour format.
32. Write a Python Program to find the largest prime factor of a number.
33. Write a Python Program for Tower of Hanoi.
34. Write a Python Program for Triangular Matchstick Number.
35. Write a Python Program to copy odd lines of one file to other.
36. Build an Amazon Price Tracker
37. Story generator using Python
38. Build a QR Code generator
39. Create a BMI Calculator
40. Create a Text To Speech converter
41. Design a Music Player

Text Books / Reference Books:

1. Brown M. C. 2018,The Complete Reference,McGraw Hill Education,Forth edition
2. Martelli A. 2003,Python in a Nutshell ,O'Reilly,First edition

Software required/Weblinks:

https://www.python.org
https://www.geeksforgeeks.org › python-programming-language
https://www.w3schools.com › python
https://www.tutorialspoint.com › python
https://docs.python.org/3.8/tutorial/introduction.html

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
Small Project
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

(BCS-DS-479A)															
BCS-DS-479A.1	-	1	-	-	-	-	-	-	-	-	-	-	1	2	3
BCS-DS-479A.2	1	-	-	-	-	2	-	-	-	-	-	-	1	3	-
BCS-DS-479A.3	-	3	3	-	-	-	2	-	-	-	-	-	1	3	-
BCS-DS-479A.4	1	-	3	-	-	2	-	-	1	2	-	-	1	2	2
BCS-DS-479A.5	-	2	-	1	-	-	1	-	-	-	1	1	2	-	3
BCS-DS-479A.6	1	2	3	-	-	-	3	2	2	-	2	2	1	2	3

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BCS-DS-428: Blockchain Technology

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-428.1. Understand what and why of Blockchain
BCS-DS-428.2. Explore the major components of Blockchain
BCS-DS-428.3. Learn about Bitcoin, Cryptocurrency, Ethereum
BCS-DS-428.4. Learn about Hyperledger Fabric model and its Architecture
BCS-DS-428.5. Identify a use case for a Blockchain application
BCS-DS-428.6. Create your own Blockchain network application

PART – A

Unit 1: Introduction to Blockchain
1.1 Digital Money to Distributed Ledgers ,
1.2 Design Primitives: Protocols, Security, Consensus, Permissions, Privacy.
1.3 Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hashchain to Blockchain, Basic consensus mechanisms

Unit 2: Consensus
2.1 Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols
2.2 Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains

Unit 3: **Introduction to Bitcoin**
3.1 Currency, Double Spending, Cryptocurrency, P2P Payment Gateway, Wallet, Mining
3.2 Ethereum: Ethereum network, EVM, Transaction fee, Mist, Ether, gas, Solidity - Smart contracts, Truffle, Web3, Design and issue Cryptocurrency

PART – B

Unit 4: Hyperledger Fabric (A) and (B):

4.1. Hyperledger Fabric (A): Decomposing the consensus process ,Hyperledger fabric components, Chaincode Design and Implementation

4.2. Hyperledger Fabric (B):Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool

Unit 5: Use case 1 and 2 :

5.1. Use case 1: Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance

5.2. Use case 2:Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc

Unit 6: Use case 3 :

6.1. Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems

6.2. Blockchain Cryptography, Privacy and Security on Blockchain

Text Books / Reference Books:

1. Mstering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill,

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-428)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-428.1	3	1	-	1	1	3	1	3	1	3	-	3	1	2	1
BCS-DS-428.2	3	1	-	1	1	3	1	3	1	3	-	3	1	2	2
BCS-DS-428.3	3	3	2	2	2	3	3	3	2	3	3	3	2	2	3
BCS-DS-428.4	3	2	2	3	2	3	2	3	1	3	2	3	3	3	3
BCS-DS-428.5	3	2	2	3	2	3	2	3	1	3	2	3	3	3	3
BCS-DS-428.6	3	2	2	3	2	3	2	3	1	3	2	3	3	3	3

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BCS-DS-481: Blockchain Technology Lab

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Blockchain Technology (BCS-DS-428)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-481.1. Learn the basic concepts of Cryptography and cryptocurrency.
BCS-DS-481.2. Design and Compile Blockchain framework.
BCS-DS-481.3. Develop programs for Bitcoin.
BCS-DS-481.4. Implement the concepts of Blockchain wallet.
BCS-DS-481.5. Demonstrate the usage of Consensus.
BCS-DS-481.6. Handle the security in Blockchain.

List of Practicals:

1. Write a program for blockchain explorer.
2. Write a program for create your own cryptocurrency
3. Write a program for creating wallets and sending cryptocurrency.
4. Write a program for Naive blockchain construction
5. Write a program to show scalability aspects of Blockchain consensus protocols
6. Write a program for Memory Hard Algorithm – Hashcash implementation
7. Write a program for creating Direct Acyclic graph.
8. Write a program for creating Ethereum.
9. Write a program for Smart contract construction.
10. Write a program for tokenization and trading cryptocurrencies.
11. Write a program to start your own Initial Coin Offerings
12. Write a program to show the usage of Hyperledger Fabric
13. Write a program to implement blockchain network and mining.
14. Write a program for mitigating attack in blockchain.
15. Create your own token and use them to buy NFT.
16. Create a smart contract for secure voting.
17. Create smart contract to store medical records securely in Blockchain

Note: At least 5 more exercises to be given by the teacher concerned.

Software required/Weblinks:
Jdk1.5
Python
https://www.javatpoint.com/blockchain-tutorial
https://www.tutorialspoint.com/blockchain/index.htm

https://www.tutorialspoint.com/python_blockchain/index.htm

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-481)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-481.1	2	1	-	1	1	1	-	2	1	2	-	2	1	2	1
BCS-DS-481.2	3	1	-	1	1	1	1	2	1	3	-	2	1	2	2
BCS-DS-481.3	2	2	1	1	2	-	3	3	2	3	3	2	2	2	2
BCS-DS-481.4	3	2	2	3	2	3	2	3	1	3	2	3	2	2	2
BCS-DS-481.5	3	2	2	3	2	3	2	3	1	3	2	3	3	3	3
BCS-DS-481.6	3	2	2	3	2	3	2	3	1	3	2	3	3	3	3

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BCS-DS-430: Software Engineering and Project Management

Periods/week Credits	Max. Marks : 200
L: 3 T: 0 3.0	Continuous Evaluation : 100
Duration of Examination: 3 Hrs	End SemExamination :100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: The Students will be able to-

BCS-DS-526.1. Define systematic approach and Project Management techniques for Software Development.
BCS-DS-526.2. Deploy appropriate Project Development plan after collecting requirements of the client.
BCS-DS-526.3. Estimate the cost, effort, schedule and staff requirement for a particular project at the planning stage.
BCS-DS-526.4. Explain the quality, risks concepts and recovery techniques for a Project.
BCS-DS-526.5. Track the project progress and learn different techniques used to manage scope, cost, schedule and quality issues.
BCS-DS-526.6. Perform various activities related to project review and closure.

PART -A

Unit-1: Software Development Life Cycle Plan

1.1 Introduction of SDLC, its importance and selection,
1.2 SDLC Models and their comparative analysis: Waterfall model, V-Shaped software DLC model, Prototype model, Structured Evolutionary & Rapid Prototyping model, RAD model and Spiral model,
1.3 Requirement Analysis and Specification
1.4 System Design: Modular Design, Design Models, Architectural Design Of Software, Data Design
1.5 Software Testing Techniques

Unit-2: Managing Software Project

2.1Project Development Techniques,
2.2 Project Management Skills,
2.3 Process Overview, Process Models,
2.4 Process planning,
2.5 Standard Processes, Customized Processes,
2.6 Requirements Change Management,
2.7 CMM Models, KPA's Project Management,
2.8 SPM life cycle.
2.9 Project Estimation Techniques, Empirical Estimation Techniques
2.10 COCOMO Heuristic Estimation Techniques

Unit-3: Effort Estimation & Scheduling

3.1 Software requirement specifications,
3.2 Project planning,
3.3 Scheduling fundamentals, Effort Estimation models,
3.4 Estimation scheduling,

3.5 Effort Estimation approaches: PERT and CPM Scheduling.

PART-B

Unit-4: Risk and recovery management
4.1 Concept of Risks & Risk Management,
4.2 Risk Assessment & Control,
4.3 Risk Management models,
4.4 Configuration Management Process
4.5 Recovery management techniques

Unit-5: Project Tracking and Controls
5.1 Schedule Management,
5.2 Milestone list, Project Crashing and fast tracking,
5.3 Crash process & Network analysis,
5.4 Project Planning and Project Size Estimation Metrics

Unit-6: **Quality Control, Project Review & Closer**
6.1 Formal technical reviews and reports, Formal approaches to software quality assurance,
6.2 Defect prevention planning,
6.3 Quality Control tools: Process flow chart, Perato chart, Run chart,
6.4 Critical Change Management,
6.5 Defect analysis and prevention,
6.6 Project Closer analysis and Reports.

Text Books / Reference Books:

1. Futrell&Shefer, 2002, Quality Software Project Management: 5th edition, Pearson Education.
2. PankajJalote, 2002, Software Project Management Practice:2nd edition, Pearson Education.
3. Sommerille, 2011, Software Engineering: 9th edition, Pearson Education.
4. Roger S. Pressman, 2001, Software Engineering – A Practitioner's approach:5th edition, McGraw Hill
5. Walker Royce, 1998, Software Project Management, 1st edition, Addison Wesley.
6. Ramesh, 2005, Managing Global software Projects, 1st edition, TMH.

Software required/Weblinks:
nptel.ac.in

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-430)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**

BCS-DS-430.1	2	-	-	-	-	-	-	-	-	-	2	-	-	2	-
BCS-DS-430.2	2	2	-	-	-	1	-	-	-	-	1	-	-	2	-
BCS-DS-430.3	-	3	-	-	1	-	-	-	-	-	3	-	-	1	-
BCS-DS-430.4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
BCS-DS-430.5	-	-	3	-	-	-	-	-	-	-	1	-	-	2	-
BCS-DS-430.6	1	3	-	-	-	-	1	-	-	-	3	-	-	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-482: MOBILE APPLICATION DEVELOPMENT LAB

Periods/week	Credits		Max. Marks	: 100
P :4	2.0		Continuous Evaluation	: 50
Duration of Exam: 2 Hrs			End Sem Examination	: 50

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-471.1. Understand enterprise scale requirements of mobile applications.
BCS-DS-471.2. Recognize the operation of the application, application lifecycle, intents, and Activities.
BCS-DS-471.3. Summarize UI - components, layouts, event handling.
BCS-DS-471.4. Illustrate custom UI elements, positioning, experiment with broadcast receivers, services, working API's for data handling
BCS-DS-471.5. Integrate and Support Live Locations and Menu.
BCS-DS-471.6. Designing and Deploying Hybrid application.

List of Practicals:
Exercise 1 - Create a Basic Application using android and ios
Exercise 2 - Working with Forms
Exercise 3 - Working with Intents
Exercise 4 - Apply Style and Theme in an App
Exercise 5 - Introduction to Scrollable Views, Tabs and Pages
Exercise 6 - Asynchronous Network Access
Exercise 7 -XCTest, Memory Management and Instruments, and Final Project Support
Exercise 8 - Create an App that does payment process via a Context Menu
Exercise 9 - Create an App that does currency converter operations using an options menu
Exercise 10 - Create an App that provides your current location on the map
Exercise 11 - Create an App that fragments the screen horizontally.
Exercise 12 - Create an App that accesses the Bluetooth and camera of your phone.
Exercise 13- Create an App that records and plays audio.
Exercise 14- Create an App displays the progress of task

Text books/ Reference Books:

1. OSS Mobile Platform, IBM ICE Publication,2018
2. David Tainar, Mobile Computing: Concepts Methodologies, Tools & Applications.
3. Barbara L Ciaramtaro, Mobile technology consumption,IGI Global,2012.
4. Head First Android Development: A Brain-Friendly Guide, 2nd Edition
5. IOS SWIFT GAME DEVELOPMENT COOKBOOK – SIMPLE SOLUTION FOR GAME DEVELOPMENT PROBLEMS,O'Reilli,2018
6. **Learning Core Data For iOS – A Hands On Guide To Building Data Application**

Software Required/Weblinks:
https://www.tutorialspoint.com/android/
https://www.javatpoint.com/android-tutorial

https://developer.android.com/guide/

Xcode and Interface Builder and git
https://www.tutorialspoint.com › ios

Note: At least 5 programs are to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-482)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-482.1	2	1	1	1	3	2	1	1	2	1	2	1	2	3	2
BCS-DS-482.2	2	2	3	2	1	2	2	2	2	2	2	2	1	2	1
BCS-DS-482.3	2	2	3	2	1	1	3	2	2	2	2	2	1	3	1
BCS-DS-482.4	2	2	3	2	1	2	3	2	2	2	2	2	1	2	1
BCS-DS-482.5	2	2	3	2	1	2	2	2	2	3	2	2	3	3	3
BCS-DS-482.6	2	2	3	2	2	2	2	3	3	2	2	2	2	3	2

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BCS-DS-472:Web Development - II

Periods/week Credits	Max. Marks	: 100
P :2 1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs	End Sem Examination	: 50

Pre-Requisite: Knowledge of HTML, CSS, JavaScript, bootstrap, angular JS
Course Type: Program Electives

Course Outcomes: The students will be able to –

BCS-DS-472.1. Create basic and advanced web applications with Node js, React.js and Native Js
BCS-DS-472.2. Identify and implement various techniques in C
BCS-DS-472.3. Understand and implement various formats related to data handling.
BCS-DS-472.4. Differentiate and implementation between server side scripting and client side scripting techniques
BCS-DS-472.5. Understand and implement MVC framework
BCS-DS-472.6. Develop the solution for the real world problem

PART –A

Unit-1: Node.js introduction and environment setup, rept terminal, NPM, callback concepts, event loop, event emmiter, buffers, streams, file system, global objects, utility modules, web module, express framework, RESTfulaplication, scaling application, packaging.

Unit-2: Introduction to React.js, History of front end libraries, Motivation for using React, Original DOM vs Virtual DOM, Environment Setup, JSX,

Unit-3: Components, component lifecycle, State, Props and props types, Props Validation, Forms, Events, Refs, Keys, Router, Flux Concepts, Animation

PART –B

Unit-4: ReactNative overview, app, state, props, styling, firebox, ListView, Text Input, ScrollView, Images, HTTP, Buttons, Animations, Debugging, Router, Running IOS, Running Android

Unit-5: React Native View, Web View, Modal, ActivityIndicator, Picker, StatusBar, Switch, Text, Alert, GeoLocation, AsyncStorage.

Unit-6: Grunt, CSS minifier, Less, Sass

Text Book / Reference Books:

1. Alex Banks and Eve Porcello, 2017, Learning React: Functional web Development with React and Redux, O'Reilly.
2. VipualAmler and PrathameshSonpatk, ReactJS by Example- Building Modern Web Applications with React, packtpub.com
3. React JS Notes for Professionals Book by goalkicker.com
4. Chris Northwood The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer, Apress
5. Gin and Beego, Hands on Full Stack Development with Go: Build full-stack web applications with

GophterJS, ReactJS, packtpub.com

Reference Websites:

1. http://www.w3schools.com
2. http://www.tutorialspoint.com
3. http://reactjs.org
4. http://nodejs.org
5. http://www.reactnative.com

Software required/Weblinks:

Web Browser
Any Text editor
Internet Connection/ Javascript libraries

Note: The faculty members are required to make sure that all the students perform at least one experiment related to the topics mentioned. In addition to this the faculty teaching the course, is required to make students identify a project during the initial lectures, and let students implement the concepts learned, as the course progresses. The evaluation should be only on the basis of, how complex the objectives were set and how much percentage of the same have been implemented in the final project, in the efficient manner.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
Small Project
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-472)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-472.1	1	3	3	3	3	3	3	1	3	2	3	3	3	3	1
BCS-DS-472.2	2	3	2	2	2	1	1	1	1	1	3	3	3	3	1
BCS-DS-472.3	1	3	3	3	3	3	3	1	1	1	3	3	3	3	1
BCS-DS-472.4	1	3	3	3	3	1	1	1	1	1	3	3	3	3	1
BCS-DS-472.5	3	3	3	3	3	1	3	1	1	1	3	3	3	3	1
BCS-DS-472.6	3	3	3	3	3	1	1	1	1	3	2	3	3	3	1

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BCS-DS-473: Programming using R

Periods/week	Credits	Max. Marks : 100
P :2	1.0	Continuous Evaluation : 50
Duration of Exam: 2 Hrs		End Sem Examination : 50

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: The students will be able to-
BCS-DS-473.1 Understand the fundamental syntax of R through readings, practice exercises, demonstrations, and writing R code.
BCS-DS-473.2 Perform appropriate statistical tests using R
BCS-DS-473.3 Analyze surveys, experiments and other data sets and present findings using the appropriate R packages.
BCS-DS-473.4 Execute and examine various operation performed on various types of data sets.
BCS-DS-473.5 Visualizing data using R with different type of graphs and charts.
BCS-DS-473.6 Design and develop the solution for the real analytical problem.

List of Practical's:
Practical 1. Basics of R, R data types and objects, reading and writing data
Practical 2: learn the Control structures, functions, scoping rules
Practical 3: Loop functions, date and time.
Practical 4. Vectors, data frames, list, matrices and writing functions
Practical 5: Importing data. (csv, xls, txt etc)
Practical 6: Mean, Median, Mode using vector
Practical 7: Plotting with ggplot2-
Practical 8: Data Analysis in R Studio. Regression analysis, correlation analysis
Practical 9: Graphs, plots , bar chart, box plot, pie chart, dot plots, scatter plots
Practical 10: A data science project –more advances
Practical 11: Write a R program to sort a given data frame by multiple column(s)
Practical 12: Create the following vectors in R.

a = (5, 10, 15, 20, ..., 160)
b = (87, 86, 85, ..., 56)
Use vector arithmetic to multiply these vectors and call the result d. Select subsets of d to identify the following.
What are the 19th, 20th, and 21st elements of d?
What are all of the elements of d which are less than 2000?
How many elements of d are greater than 6000? Return TRUE or FALSE.
Find the elements of a given vector that are not in another given vector.
To test whether the value of the element of a given vector greater than 10 or not.

Practical 13. Write a R program to find row and column index of maximum and minimum value in a given matrix.
Practical 14. Write a R program to create a list containing a vector, a matrix and a list and give names to the elements in the list. Access the first and second element of the list
Practical 15: Using radiology datasets, use R to compute the following statistics of data sets:

(a) sum
(b) median
(c) standard deviation

Practical 16: From the radiology data, examine the histograms and box plots of clinic visits and radiology visits. (Note: these will be two separate box plots, not a single side-by-side box plot as above.

(d)

Practical 17. Use R to create the following two matrices and do the indicated matrix multiplication.

$$\begin{bmatrix} 7 & 9 & 12 \\ 2 & 4 & 13 \end{bmatrix} \times \begin{bmatrix} 1 & 7 & 12 & 19 \\ 2 & 8 & 13 & 20 \\ 3 & 9 & 14 & 21 \end{bmatrix}$$

Practical 18: The dataset related to RADIOLOGY .contains hospital information for 31 months: visits to radiology, patient-days, and clinic visits. Save this file and use read. Table to import it into R.

What are the means and standard deviations of the four data variables (excluding month)?

Write a R program to call the (built-in) dataset air quality. Check whether it is a data frame or not? Order the entire data frame by the first and second column

Practical 19: From the radiology data, construct a scatter plot of clinic visits (x) versus radiology visits (y). Perform the simple linear regression of radiology visits on clinic visits and add the regression line to the plot. Briefly comment on the fit.

Practical 20: Create a Recommender System and generate 3D graph using dplyr package

Practical 21: Design visualization of COVID 19 data for India

Practical 22: Design a system for fake news detection.

Software required/ Weblinks :

R studio 3.3.2

https://www.tutorialspoint.com/r/index.htm

http://manuals.bioinformatics.ucr.edu/home/programming-in-r

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab

File work/Class Performance

Viva (Question and answers in lab)

End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-473)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-473.1	3	3	3	2	2	-	-	-	1	-	-	1	-	-	-
BCS-DS-473.2	2	3	2	2	3	-	2	-	-	-	1	-	1	1	1
BCS-DS-473.3	2	2	3	3	2	-	2	-	1	1	1	-	1	-	-
BCS-DS-473.4	3	2	3	3	2	-	2	2	-	1	1	-	-	-	1
BCS-DS-473.5	3	3	3	2	2	2	2	-	1	-	-	-	1	1	-
BCS-DS-473.6	-	3	3	3	2	3	3	2	-	-	1	-	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-478:XML based lab

Periods/week	Credits	Max. Marks : 100
P :4	2.0	Continuous Evaluation : 50
Duration of Exam: 2 Hrs		End Sem Examination : 50

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to
BCS-DS-478.1 Understand the basic concept of XML language.
BCS-DS-478.2 Demonstrate the XML document using the ER diagrams
BCS-DS-478.3 Apply Queries in different scenarios.
BCS-DS-478.4 Create External DTD and Schemas.
BCS-DS-478.5 Designstylesheets.

List of Practicals:
1. Write a program to create well formed XML.
2. Write a program to generate an XML document using the ER Diagram.
3. Write a program to write a XPATH query for the given Scenarios.
4. Write a program to Create an External DTD and Schema for the particular specification.
5. Write a program to apply Stylesheet to XML.
6. Write a program to write XSL Transformations and link the XML files to them to produce particular output when the XML files are opened in a browser
7. Write a program in XML using Schema
8. Write a program in XML using CSS with DTD.
9. Write a program in XML using CSS with border and table property
10. Write a program in XML using CSS with XSLT
11. Write a program in XML using CSS using different colour properties
12. Write a program in XML using CSS using different text transformation properties

Software required/Weblinks:
- XML Programming Bible -Brian Benz
- Learning XML by Erik T. Ray
- http://www.w3schools.com/xml/
- http://www.w3schools.com/xml/xml_whatis.asp

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-478)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-478.1	2	1	-	-	3	-	-	-	-	-	-	1	1	1	2
BCS-DS-478.2	3	-	-	3	2	-	-	-	-	-	-	-	1	2	2
BCS-DS-478.3	3	1	2	3	-	-	-	-	-	-	-	-	1	2	-
BCS-DS-478.4	2	3	1	2	3	-	-	-	-	-	-	1	3	2	-
BCS-DS-478.5	-	2	1	2	2	-	-	-	-	-	-	2	2	3	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A++' Grade University
BCS-DS-450 : Spring Boot

Periods/week Credits		Max. Marks : 200
L : 3 T:0 3.0		Continuous Evaluation : 100
Duration of Exam: 3 Hrs		End Sem Examination : 100

Pre-Requisite: NIL
Course Type: Elective
Course Outcomes: The students will be able to-

BCS-DS-450.1: Understand Spring Boot Concepts.
BCS-DS-450.2: Learn the key terminologies and utilize these for building Spring Boot Applications
BCS-DS-450.3: Implement database connectivity and create applications.
BCS-DS-450.4: Create web Applications and test the applications.

PART-A

Unit-1: Spring Boot Concepts
1.7 Spring Boot Features
1.8 Spring Boot Architecture, Spring Vs Spring Boot
1.9 Spring Initializr
1.10 Spring Boot CLI
1.11 Spring Tool Suite: Installation and Configuration
1.12 Building First Spring Boot Project, Spring Boot Annotations, Spring Boot Starters

Unit-2: Spring Boot Aspect Oriented Programming
2.5 Introduction to AOP, Benefits
2.6 AOP Terminology: Aspect, Pointcut, Java Point, Advice, Target object, Weaving, proxy
2.7 Different AOP Advices, Spring Boot Starter AOP

Unit-3: Spring Boot Database
3.1 Spring Boot JPA: features, need of JPA
3.2 JPA Architecture, JPA Class Relationship, Object-Relation Mapping (ORM), Spring Boot JPA Example.
3.3 Spring Boot JDBC, JDBC Connection Pooling: HikariCP, need of Spring Boot JDBC, Spring Boot JDBC Example.
3.4 Spring Boot CRUD Operations

PART-B

Unit-4: Introduction to SOAP Web Service
4.1 Introduction to Web Services: Overview
4.2 Web Services Terminology: Request and Response, Message Exchange Format: XML and JSON, Service Definition, Service Provider, Service Consumer, Transport
4.3 Web Service Groups: SOAP, REST, Advantages, Constraints

Unit-5: Spring Boot SOAP Web Service
5.1 SOAP Web Service: Initialization, Creation using Contract First Approach, Defining Request/Response XML Structure, XSD for Request/Response
5.2 Spring Boot Web Service Configuration: Dispatcher Servlet, WSDL
5.3 Implementing a service
5.4 Exception Handling and SOAP Fault Responses
5.5 Implementing Security for SOAP Web Services with WS Security

Unit-6: Testing With Spring Boot
6.1 Integration Testing auto-Configuration
6.2 Testing Web Applications: Mocking Spring MVC, Testing Web Security
6.3 Testing a running application

Text Books/ Reference Books:

1. Spring Boot in Action, Craig Walls, Manning Publication.
2. Learning Spring Boot 3.0-Third Edition, Greg L. Turnquist, Dave Syer, Mark Heckler, Josh Long, December 22, Packt Publishing
3. Mastering Spring Boot 2.0: Build modern, cloud-native, and distributed systems using Spring Boot, Dinesh Rajput, Packt Publishing

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-450)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-450.1	3	2	1	2	2	3	2	1	2	2	2	3	2	2	3
BCS-DS-450.2	3	2	2	2	2	3	3	2	3	2	3	3	3	3	2
BCS-DS-450.3	2	1	2	1	2	2	1	1	3	1	3	3	3	2	2
BCS-DS-450.3	1	3	2	2	3	1	1	1	2	1	2	2	2	2	3

NAAC 'A++' Grade University
BCS-DS-491 : Spring Boot Lab

Periods/week Credits Max. Marks : 100
L:0 T:0 P :2 1.0 Continuous Evaluation : 50
Duration of Exam: 2 Hrs End Sem Examination : 50
Pre-Requisite: NIL
Course Type : Elective
Course Outcomes: The students will be able to-

BCS-DS-491.1: Gain practical knowledge in developing Spring Boot applications.
BCS-DS-491.2: Learn how to integrate Spring Boot with databases and other technologies.
BCS-DS-492.3: Develop problem-solving skills through practical exercises and projects.

List of Practicals:

1.Set up the development environment by installing Java, Maven, and an IDE (e.g., Eclipse, IntelliJ). Create a basic Spring Boot application using the Spring Initializer.
2.Create a simple RESTful API.
3.Create and test endpoints to perform CRUD operations on a specific resource (e.g., User, Product)
4.Set up a relational database like MySQL or PostgreSQL and integrate database with spring boot application.
5.Create a custom exception class, such as Resource Not Found Exception, to represent a specific type of exception. Define methods in the exception handler to handle exception and return appropriate error responses
6.Write unit tests for your Spring Boot application using JUnit and Mockito.
7.Implement integration tests using the Spring Boot testing framework.
8.Build an online book store, that allows customers to browse and purchase books, manage their orders, and provide administrative functionality for managing books and order.
9.Create a web application for the Task Management System using Spring Boot that allows users to manage their tasks and collaborate with others. The system supports features such as task creation, assignment, tracking, and reporting.
10.Build an online voting system where users can vote for candidates or proposals.

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab

File work/Class Performance

Viva (Question and answers in lab)

End Semester Practical Examination

Course Articulation Matrix:

CO Statement (BCS-DS-491)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-491.1	3	2	1	2	2	3	2	1	2	2	2	3	2	2	3
BCS-DS-491.2	3	2	2	2	2	3	3	2	3	2	3	3	3	3	2
BCS-DS-491.3	2	1	2	1	2	2	1	1	3	1	3	3	3	2	2

NAAC 'A++' Grade University
BCS-DS-455 : Interface Design for HCI

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Nil
Course Type: Elective
Course Outcomes: The students will be able to-
BCS-DS-455.1. To learn the foundations of Human Computer Interaction.
BCS-DS-455.2. To be able to apply HCI and its principles to interaction design.
BCS-DS-455.3. To become familiar with the design technologies for individuals and persons with disabilities.
BCS-DS-455.4. To learn the guidelines for user interface.

PART-A

Unit-1: Introduction
1.1Importance of user Interface – definition, importance and benefits of good design.
1.2A brief history of Screen design
1.3The graphical user interface – popularity of graphics, concept of direct manipulation, graphical system, Characteristics
1.4Web user Interface, popularity, characteristics, Principles of user interface.

Unit-2: Design Process
2.1Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.
2.2Screen Designing: Design goals – Screen planning and purpose
2.3Organizing Screen Elements, ordering of screen data and content
2.4Screen Navigation and flow- Visually pleasing composition
2.5Amount of information-focus and emphasis-presentation of information simply and meaningfully
2.6Information Retrieval on web-statistical graphics- Technological consideration in interface design.

Unit-3: GUI
3.1 Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls.
3.2 Components – text and messages, Icons,
3.3 Multimedia, Colors, choosing colors, user problems.

PART-B

Unit-4: HCI in Software Processes

4.1 The software life cycle, Usability engineering
4.2 Iterative design and prototyping
4.3 Design Focus: Prototyping in practice, Design rationale, Design rules, Principles to support usability

Unit-5: Evaluation
5.1 Standards Golden rules and heuristics
5.2 HCI patterns Evaluation techniques
5.3 Goals of evaluation, Choosing an evaluation method, Evaluation through expert analysis, Evaluation through user participation,.
5.4 Universal design, Universal design principles Multi-modal interaction

Unit-6: Advanced Topics
6.1 Cognitive models, Goals, Task hierarchies
6.2 Design Focus: GOMS saves money Linguistic models
6.3 The challenge of display-based systems, Physical and device models, Cognitive architectures
6.4 Ubiquitous computing and augmented realities
6.5 Ubiquitous computing applications

Text Books/ Reference Books:

1. The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech.
2. Human – Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg,Pearson Education
3. Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia.
4. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
5. User Interface Design, Soren Lauesen , Pearson Education.
6. Human –Computer Interaction, D. R. Olsen, Cengage Learning.
7. Human –Computer Interaction, Smith - Atakan, Cengage Learning

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Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-455)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-455.1	3	1	1	1	1	1	1	1	1	1	1	2	1	1	1
BCS-DS-455.2	1	3	2	2	3	1	3	1	2	1	2	1	2	1	2
BCS-DS-455.3	2	2	3	1	3	1	1	3	1	1	3	2	3	1	3
BCS-DS-455.4	1	1	1	3	3	1	1	1	1	2	1	1	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A++' Grade University
BCS-DS-492 : Interface Design for HCI Lab

Periods/week Credits Max. Marks : 100

P :2 1.0 Continuous Evaluation : 50
Duration of Exam: 2 Hrs End Sem Examination : 50

Pre-Requisite: NIL

Course Type : Elective

Course Outcomes: The students will be able to-

BCS-DS-492.1. Construct design sketches and prototypes to manifest design ideas.
BCS-DS-492.1. Reflect on the design process to map the requirements and ease of learning.
BCS-DS-492.1. Carry out usability studies to get feedback on the user experience.

List of Practicals:

1. Create a GUI based web application.
2. Write a web application for highlighting web user interface.
3. Write a web application to place different screen elements.
4. Write a web application illustrating screen navigation and flow
5. Create a web application for information retrieval on web statistical graphics
6. Write a web application exhibiting multimedia application usage.
7. Write a web application using software development life cycle
8. Write a web application making use of multimodel interactions
9. Create a web application to exhibit display based systems
10. Write a web application based on linguistic model.

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

Course Articulation Matrix:

CO Statement (BCS-DS-492)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PS O 1	PS O 2	PS O 3
BCS-DS-492.1	2	1	3	2	3	1	1	2	2	1	2	1	1	2	1
BCS-DS-492.2	1	2	3	3	3	1	2	2	3	3	3	2	2	3	2
BCS-DS-492.3	1	3	3	2	3	3	3	1	3	3	2	3	2	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A++' Grade University

BCS-DS-456 : Augmented Reality & AR Core

Periods/week Credits Max. Marks : 200
L :3 T: 0 3.0 Continuous Evaluation : 100

Duration of Exam: 3 Hrs End Sem Examination : 100

Pre-Requisite: NIL

Course Type: Elective

Course Outcomes: Students will be able to-

BCS-DS-456 .1. Describe how AR systems work and list the applications of AR.

BCS-DS-456 .2. Understand and analyse the hardware requirement of AR.

BCS-DS-456 .3. Use computer vision concepts for AR and describe AR techniques.

BCS-DS-456 .4. Impart the importance of augmented reality in Industry 4.0 with real-time examples

BCS-DS-456 .5. Analyse and understand the working of various state of the art AR devices

BCS-DS-456 .6. Acquire knowledge of ARcore

PART –A

Unit-1. Introduction to Augmented Reality:

1.1 History of AR
1.2 Augmented reality characteristics
1.3 Difference between Augmented Reality and Virtual Reality
1.4 AR technological components
1.5 Hardware components and Software tools
1.6 AR importance, types and real world use

Unit-2. Augmented Reality Hardware

2.1 Augmented Reality Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception , Requirements and Characteristics, Spatial Display Model.
2.2 Processors – Role of Processors, Processor System Architecture, Processor Specifications
2.3 Tracking & Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.

Unit-3. Computer Vision for Augmented Reality & A.R. Software

3.1 Computer Vision for Augmented Reality - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking
3.2 Augmented Reality Software - Introduction, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application

PART –B

Unit-4. AR Techniques- Marker based & Markerless tracking

4.1 Marker-based approach- Introduction to marker-based tracking, types of markers, marker camera pose and identification, visual tracking, mathematical representation of matrix multiplication
4.2 Marker types- Template markers, 2D barcode markers, imperceptible markers.
4.3 Marker-less approach- Localization based augmentation, real world examples
4.4 Tracking methods- Visual tracking, feature based tracking, hybrid tracking, and initialisation and recovery.

Unit-5. AR Devices & Components

5.1 AR Components – Scene Generator, Tracking system, monitoring system, display, Game scene
5.2 AR Devices – Optical See- Through HMD, Virtual retinal systems, Monitor based systems, Projection displays, Video see-through systems

Unit-6. Building AR apps using ARCore

6.1 Introduction to ARCORE
6.2 Developing an AR app using ARCORE
6.3 Packaging an app to run on android devices
6.4 Plugins for AR apps

Text Books/Reference Books:

1. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
2. Micheal Lanham, Learn ARCore - Fundamentals of Google ARCore (1 ed.), Packt Publishing, 2018. ISBN 9781788833639, 1788833635
3. Jonathan Linowes, KrystianBabilinski – Augmented Reality for Developers: Build practical augmented reality applications with Unity, ARCore, ARKit, and Vuforia.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional Tests
Surprise questions during lectures/Class Performance
End Sem Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-456 .1	2	1	1	1	1	1	1	1	1	2	1	3	2	1	2
BCS-DS-456 .2	3	3	1	1	1	2	1	1	1	1	1	2	1	1	1
BCS-DS-456 .3	3	3	1	1	1	3	3	1	1	2	1	3	2	1	1
BCS-DS-456 .4	3	2	3	3	2	3	2	2	3	2	1	3	2	1	2
BCS-DS-456 .5	3	3	2	3	2	3	1	1	2	2	1	3	1	1	2
BCS-DS-456 .6	3	2	2	1	2	3	1	2	3	2	1	3	2	3	2

SEMESTER – V

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-501: Design & Analysis of Algorithms

Periods/week	Credits	Max. Marks : 200
L :3 T: 1	4.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs		End Sem Examination : 100

Pre-Requisite: Data Structures & Algorithms (BCS-DS-301)
Course Type: Program Core

Course Outcomes: Students will be able to-
BCS-DS-501.1. Remember and relate algorithms and their complexity.
BCS-DS-501.2. Understand various problem-solving algorithms.
BCS-DS-501.3. Apply and examine different algorithmic methods on real life problems.
BCS-DS-501.4. Analyze graph and network concepts.
BCS-DS-501.5. Evaluate a series and NP completeness of a problem.
BCS-DS-501.6. Create and assemble advanced features of algorithms and the improvement of computational efficiency.

PART- A

Unit 1: Algorithm and its performance analysis
1.1 Introduction: Characteristics of algorithm.
1.2 Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs.
1.3 Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

Unit 2:Fundamental Algorithmic Strategies (Part-I)
2.1 Brute-Force method.
2.2 Divide and Conquer (Strassen's matrix multiplication, finding maximum and minimum, Convex hull).
2.3 Greedy problem (KnapSack problem, Huffman algorithm, Single source shortest path, Minimum cost spanning trees, Task scheduling algorithm).
2.4 Dynamic Programming (All pairs shortest path, Single source shortest path, Optimal BST, 0/1 Knapsack, Travelling salesman problem, Matrix chain multiplication, Longest common subsequence).

Unit 3:Fundamental Algorithmic Strategies (Part-II)
3.1 Branch and Bound method (0/1 Knapsack problem, Travelling salesman problem).
3.2 Backtracking method (N-queens problem, Sum of subsets, Graph coloring, Hamiltonian cycle, Knapsack problem).
3.3 Heuristics –characteristics and their application domains.

PART - B

Unit 4: Graph Theory
4.1 Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS).
4.2 Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Floyd-Warshall algorithm.4.3 Topological sorting, Network Flow Algorithm.

Unit5: String matching and NP completeness
5.1 String Matching algorithms: Naïve string-matching algorithm, Rabin-karp algorithm, String matching with finite automata, Knuth-Morris-pratt algorithm.
5.2 Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard.

5.3 Cook’s theorem, Standard NP-complete problems and Reduction techniques.

Unit6:Advanced Topics
6.1 Approximation algorithms, Randomized algorithms.
6.2 Class of problems beyond NP – P SPACE.

Text Books/ Reference Books:
1. Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C., 2009. Introduction to algorithms. MIT press.
2. Sahni, S. and Horowitz, E., 1978. Fundamentals of computer algorithms. Computer Science Press.
3. Singhal, S., 2018. ANALYSIS AND DESIGN OF ALGORITHMS. BPB Publications.

Suggested reference books
1. Dietzfelbinger, M., 2008. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, Algorithms, McGraw Hill, Boston (2007), p. x+ 320, Paperback $33.75, ISBN: 978-007352340-8 J
2. on Kleinberg, ÉvaTardos, Algorithm Design, Pearson/Addison Wesley, Boston (2006), p. xxiii+ 838, Hardcover $103, ISBN: 978-032129535-4.
3. Goodrich, M.T. and Tamassia, R., 2006. Algorithm design: foundation, analysis and internet examples. John Wiley & Sons.
4. Manber, U., 1989. Introduction to algorithms: a creative approach. Addison-Wesley Longman Publishing Co., Inc.

Web links:
1. https://www.tutorialspoint.com
2. https://www.geeksforgeeks.org
3. https://www.programiz.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-501)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-501.1	3	3	-	-	3	3	-	3	1	2	-	3	2	-	-
BCS-DS-501.2	2	2	3	3	-	1	2	-	-	-	-	3	-	3	-
BCS-DS-501.3	2	2	3	3	-	1	2	-	-	-	-	3	-	3	-
BCS-DS-501.4	3	-	2	1	2	-	2	-	3	2	2	3	2	3	2
BCS-DS-501.5	-	2	3	3	2	-	-	2	3	-	2	3	2	3	2
BCS-DS-501.6	-	-	3	1	3	3	2	3	3	2	2	-	3	-	3

BCS-DS-502: Formal Language & Automata Theory

Periods/week Credits	Max. Marks : 200
L :3 T: 1 4.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Core

Course Outcomes: Students will be able to-

- BCS-DS-502.1. Recognize and manipulate the different concepts of formal languages such as formal proofs, (non-)deterministic automata, regular expressions, regular languages, context-free grammars, context-free languages, Turing machines.
- BCS-DS-502.2. Understand about the finite automata and conversion between deterministic and non-deterministic finite automata.
- BCS-DS-502.3. Prove and examine the properties of regular languages and automata with rigorously formal mathematical methods.
- BCS-DS-502.4. Analyze and design PDA for corresponding context-free grammars accepting or generating a certain language.
- BCS-DS-502.5. Evaluate and construct a TM for certain language.
- BCS-DS-502.6. Specify the computability and tractability of various class of problems.

PART-A

Unit-1: Introduction to Formal languages

- 1.1 Overview: Alphabets, Strings & Languages, basic Definition of Grammar
- 1.2 Chomsky Classification of Languages: Regular, context free, unrestricted, Context sensitive grammar and corresponding languages
- 1.3 Derivation & Languages generated by a Grammar
- 1.4 Relation between languages of classes.

Unit-2 Automata theory

- 2.1 Finite Automata, representation of FA,
- 2.2 Deterministic finite Automata (DFA) & Nondeterministic finite Automata (NDFA),
- 2.3 Subset Algorithm to convert NDFA to DFA , Minimization of Finite Automata.
- 2.4 Finite State Machine with output- Moore machine and Melay Machine,
- 2.5 Conversion of Moore machine to Melay Machine & Vice-Versa

Unit-3: Regular languages

- 3.1 Regular Expressions
- 3.2 Equivalence of Finite Automata and Regular Expressions.
- 3.3 Regular expressions, identity rules. Arden's theorem state and prove
- 3.4 Inter conversion of regular expression and FA.
- 3.5 The Pumping Lemma for Regular Sets, Applications of the pumping lemma
- 3.6 Closure properties of regular sets.

PART -B

Unit-4: Context Free languages and push down Automata

- 4.1 Properties of context free grammar, definition, Context free
- 4.2 Ambiguity in context free grammar, Derivation tree, application of Context free Grammars
- 4.3 Simplification of Context Free grammar Reduced forms Removal of useless Symbols and unit production
- 4.4 Chomsky Normal Form (CNF) and Greibach Normal Form (GNF)
- 4.5 Pumping lemma for CFG.
- 4.6 Introduction to Push down Stack Machine Deterministic PDA, Non Deterministic PDA
- 4.7 Acceptance of CFL, Acceptance by final state and acceptance by empty state.
- 4.8 Equivalence of CFL and PDA, interconversion

Unit 5: Unrestricted language and Turing Machine

- 5.1 Unrestricted languages, Church–Turing thesis
- 5.2 Turing Machine, definition, model
- 5.3 Design of TM
- 5.4 Variations of Turing Machines, Universal Turing Machine, Post Machine

Unit-6: Computability and Intractability

6.1 Halting problem of Turing Machine
6.2 Problem of Decidability and Undesirability , Examples of Undecidable problem
6.3 Intractable Problems: The Classes P and NP, An NP-Complete Problem.
6.4 Post-Correspondence Problem.
6.5 Properties of Recursion and Recursively Enumerable Languages;
6.5 Rice's theorem

Text Books / Reference Books:

1. Hopcroaft J.E., Ullman, J.D., and Rajiv Motwani, 2001, Introduction to Automata Theory, Language & Computations, 3rd Ed.,AW.
2. Mishra K.L.P.& N. Chandrasekaran, 2000, Theory of Computer Science Automata, Languages and Computation,5th Ed. , 2000, PHI.
3. Peter Linz, 2001, Introduction to formal Languages & Automata, 3rd Ed., Narosa Publ..
4. Deniel I.A. Cohen, 2000, Introduction to Computer Theory, 2nd Ed., Wiley.
5. H.R. Lewis &C.H. Papaditriou, 1998, Elements of theory of Computation, 2nd Ed., PHI.
6. Martin J.C , 2003, Introduction to Languages and Theory of Computation, 4th Ed., TM

Software required/Weblinks:

www.vidyarthiplus.com/vp/thread_16699.html
www.cs.umb.edu/ppt/module8

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Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-502.1)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-502.1	2	2	1	3	3	1	1	1	2	2	2	2	2	2	2
BCS-DS-502.2	2	3	2	3	3	2	2	2	2	3	1	1	2	2	3
BCS-DS-502.3	1	2	2	2	2	2	1	1	3	2	1	1	3	1	3
BCS-DS-502.4	3	3	2	3	3	1	1	1	2	1	2	2	2	1	2
BCS-DS-502.5	2	1	1	2	1	2	2	1	2	1	1	3		3	3
BCS-DS-502.6	2	3	3	1	3	3	3	3	3	3	3	1		3	3

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BCS-DS-503: Artificial Intelligence

Periods/week Credits	Max. Marks : 200
L :3 T: 0 3.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Core

Course Outcomes: Students will be able to-

BCS-DS-503.1. List the basic problems solved using Artificial Intelligence techniques.
BCS-DS-503.2. Explain artificial intelligence techniques and their application areas.
BCS-DS-503.3. Practice various methods of knowledge representation and reasoning.
BCS-DS-503.4. Examine different artificial techniques and learning systems.
BCS-DS-503.5. Judge the concepts of knowledge acquisition in perspective of expert system and intelligent agents.
BCS-DS-503.6. Create a basic expert system.

PART-A

Unit-1: Introduction to AI and its Languages

1.5 Foundation and history of AI,
1.6 AI programming languages,
1.7 Introduction to AI languages: Elements of LISP and PROLOG Languages.
1.8 AI problems and techniques, formulation of problem,
1.9 Problem characteristics. Production System and Production System characteristics,

Unit-2: AI Search Techniques

2.1. Heuristic Search Techniques: Generate and Test,
2.2. Hill Climbing, Steepest Hill Climbing,
2.3. Best First Search, A*,
2.4. Problem Reduction, AO*,
2.5. Constraint Satisfaction,
2.6. Means-Ends Analysis.
2.7. Optimization and search such as stochastic annealing and genetic algorithm.

Unit-3: Knowledge Representation

3.1 Knowledge-Representation, KR Approaches and Issues,
3.2 Procedural and Declarative knowledge,
3.3 Predicate Logic: Representation and resolution,
3.4 Logic programming, Forward and Backward Reasoning,
3.5 Slot and Filler structures: Semantic Nets,
3.6 Frames,
3.7 Conceptual Dependency and
3.8 Scripts.

PART-B

Unit-4: Reasoning

4.1 Limitations of Monotonic Systems,
4.2 Basic Concepts of Non-Monotonic Reasoning Systems,
4.3 Default Reasoning, Probability Based Reasoning, Bayes Theorem,
4.4 Certainty factors and Dempster-Shafer Theory of Evidential reasoning
4.5 Fuzzy Based Reasoning Systems.

Unit-5: Expert Systems and Intelligent Agents

5.1 Definition and Characteristics of Expert Systems,
5.2 Rule Based Systems Architecture, Knowledge Acquisition Concepts, Inference Engine,
5.3 Intelligent Agents: Definition, Structure of Agents, Types of Agents,
5.4 Intelligent System.

Unit-6: Applications

6.1 Application to Game: Game tree,
6.2 Min-max search procedure,
6.3 Alpha beta pruning.
6.4 Natural Language Processing: Introduction, syntactic, semantic, discourse and pragmatic processing,
6.5 Robotics.

Text Books / Reference Books:

6. Elain Rich and Kevin Knight, 2009, Artificial Intelligence, 3rd edition, Tata McGraw Hill.
7. Stuart J.Russel and Peter Norvig, 2009, Artificial Intelligence-A modern approach: 3rd edition, Pearson.
8. Patrick Henry Winston, 1992, Artificial Intelligence , 3rdedition, , Pearson.
9. George F Luger, 2009, Artificial Intelligence : Structures and Strategies for Complex Problem Solving , University of New Mexico,6th edition, Pearson.
10. V S Janakiraman, Parerback, 2005, Foundations of Artificial Intelligence And Expert Systems : 3rd edition, Macmillan India Limited

Software required/Weblinks:

http://artint.info/html/ArtInt_351.html
http://www.tutorialspoint.com/artificial_intelligence/
http://www.compinfo-center.com/tpai-t.htm

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-503)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-503.1	2	2	1	2	2	1	1	1	2	2	2	2	2	2	3
BCS-DS-503.2	2	3	2	3	3	2	2	2	2	3	2	3	2	2	3
BCS-DS-503.3	3	2	2	2	2	2	1	1	3	2	3	3	3	3	3
BCS-DS-503.4	3	3	2	3	3	1	1	1	3	1	2	2	2	3	3
BCS-DS-503.5	2	1	1	2	1	2	2	1	2	1	1	3		3	3
BCS-DS-503.6	2	1	3	1	3	3	3	3	3	3	3	3		3	3

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BCS-DS-551: Design & Analysis of Algorithms Lab

Periods/week Credits Max. Marks : 100

P :2	1.0	Continuous Evaluation	:	50
Duration of Exam: 2 Hrs		End Sem Examination	:	50

Pre-Requisite: Data Structures & Algorithms Lab (BCS-DS-351)
Course Type: Program Core

Course Outcomes: Students will be able to-
BCS-DS-551.1. Understand the programs, their working and code accordingly.
BCS-DS-551.2. Analyze the programs based on time complexity.
BCS-DS-551.3. Select algorithms on the basis of optimality.
BCS-DS-551.4. Learn different methods of solving similar problems.
BCS-DS-551.5. Solve any problem using different approaches.
BCS-DS-551.6. Learn how to correlate different techniques.

List of Practical's:

1. WAP to sort a set of numbers into ascending/ Descending order using different sorting algorithms and calculate the time complexity by step-count method. Take the input-set from a table and repeat the operation several times 10,20,30,40 times and plot a graph.
   Examine the best case, worst-case and average case by taking suitable input data.
2. WAP for string matching by (i) Naive-string matching method and (ii) Rabin-Karp algorithm and compare number of operations done in these methods.
3. WAP for string matching using finite Automata method and Knuth-Morris-Pratt Algorithms.
4. WAP to find a number in an array by binary search method.
5. WAP to sort a set of numbers using (i) Merge sort and (ii) Quick-sort using divide and conquer method.
6. WAP for multiplications of two Matrices using Strassen's Multiplication Algorithms.
7. WAP to solve Knapsack problem using Greedy Algorithm.
8. WAP to solve Job Sequencing Problem with deadlines using Greedy algorithm.
9. Implement Graph on two-dimensional array and use Greedy method to obtain minimum-cost spanning tree of the graph.
10. WAP for Matrix-Chain Multiplication using Dynamic programming.
11. WAP to find the Largest Common Subsequence of two sets using Dynamic programming.
12. WAP for optimal binary search of an element in a array using Dynamic programming.
13. WAP for 0/1 Knapsack problem using Dynamic programming.
14. WAP for solution space for 8 Queen Problem and solve the problem using Back-Tracking method.
15. WAP for Sum of subsets problem of a given set using back tracking method.

Note: At least 5 more exercises to be given by the teacher concerned.
Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-551)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-551.1	1	1	3	1	2	-	-	-	1	2	-	-	-	3	3

BCS-DS-551.2	2	3	3	2	-	-	-	-	1	2	-	-	-	3	3
BCS-DS-551.3	1	3	3	2	-	-	-	-	-	-	-	-	-	3	3
BCS-DS-551.4	1	3	3	2	-	-	-	-	-	1	-	-	-	3	3
BCS-DS-551.5	1	3	3	2	-	-	-	-	1	1	-	-	-	3	3
BCS-DS-551.6	1	3	3	3	-	-	-	-	1	1	-	-	-	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-552: Artificial Intelligence Lab

Periods/week Credits Max. Marks : 100

P :2 1.0 Continuous Evaluation : 50
Duration of Exam: 2 Hrs End Sem Examination : 50

Co-Requisite: Artificial Intelligence (BCS-DS-503)
Course Type: Program Core

Course Outcomes: Students will be able to-
BCS-DS-552.1. Apply various techniques for solving problems using prolog programming Language.
BCS-DS-552.2. Implement the elementary searching algorithms.
BCS-DS-552.3. Examine and implement the different sorting algorithms.
BCS-DS-552.4. Simulate the various graph traversing algorithm.
BCS-DS-552.5. Design different problems such as monkey banana problem and tower of Hanoi using PROLOG.
BCS-DS-552.6. Practice different production rules in water jug problem using PROLOG.

Study of PROLOG
1. Write a program to calculate the factorial of a number.
2. WAP to show binding of compound objects.
3. WAP to append the elements in a list.
4. WAP to find the length of a list.
5. WAP to find the element of a list given the specified position.
6. WAP to reverse the list.
7. WAP to find the intersection and union of two sets.
8. Write a program to create login window.

Problems of AI
9. Write a program to solve 8 queens problem.
10. Solve any problem using depth first search.
11. Solve any problem using best first `search.
12. Solve 8-puzzle problem using best first search
13. Solve water jug problem giving all the production rules.
14. Solve Monkey banana problem.
15. Solve Tower of Hanoi.
16. WAP to sort the elements in a list using quick sort.
17. WAP to sort the elements in a list using merge sort.

Text Books / Reference Books:
1. Carl Townsend, 2010, Introduction to Turbo prolog, 2nd edition, Sybex, Wiley.
2. Ivan Bratko, 2011, Prolog Programming for Artificial Intelligence, 4th edition, , Pearson Education(US)

Software required/Weblinks:
Turbo Prolog 2.0
Dosbox

Note: At least 5 programs are to be given by the teacher concern.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-552)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-552.1	2	2	2	1	1	-	-	-	1	-	1	-	2	2	1
BCS-DS-552.2	1	1	1	1	-	-	-	-	-	-	-	-	-	1	2
BCS-DS-552.3	1	1	2	1	-	-	-	-	-	-	-	-	-	1	2
BCS-DS-552.4	1	1	1	1	-	-	-	-	-	-	-	-	-	1	2
BCS-DS-552.5	1	1	1	1	-	-	-	-	1	-	-	-	-	1	1
BCS-DS-552.6	1	1	1	1	-	-	-	-	1	-	-	-	-	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

Proj-CS-500: SUMMER INTERNSHIP –II**

Periods/week Credits Max. Marks : 100

4 weeks Minimum 2.0 Continuous Evaluation : 100
Duration of Exam: 2 Hrs

Pre-Requisite: Basic Knowledge of computers
Course Type: Projects

Course Outcomes: Students will be able to-
Proj-CS-500.1. Actually face challenges of real field work.
Proj-CS-500.2. Apply their learning skills to solve real life problem.
Proj-CS-500.3. Show the research capability.
Proj-CS-500.4. Enhance their Innovative skills.
Proj-CS-500.5. Develop solutions.
Proj-CS-500.6. Build technology for new areas.

Every student will have to undergo Industrial Training for 6 weeks in the relevant field of Engineering in which he/she is enrolled for B.Tech programme after 4th semester. Respective Head of Department will approve the Industry/Organization for training. During this course of time he/she will be regularly monitored and evaluated. After successful completion of the training, the student will have to submit the training report, deliver a seminar about the work/project undertaken during the training and will have to appear for viva. The evaluation of the industrial training shall be made as per following:

Continuous Evaluation during training:
1. Evaluation by the Supervisor in the Industry : 25 marks
2. Evaluation by Faculty Mentor during training visit : 10 marks
3. Internal seminar/ Presentation : 15 marks
Total Marks : **50**

End Term Evaluation after training:
1. Project Report : 10 marks
2. Seminar/Presentation : 20 marks
3. Viva : 20 marks

Total marks **50**

Total Credits : 2

COURSE ARTICULATION MATRIX :

CO Statement (Proj-CS-500)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
Proj-CS-500.1	1	2	3	-	-	-	2	2	3	3	2	3	1	2	3
Proj-CS-500.2	1	3	3	-	-	-	2	3	3	2	2	3	1	2	3
Proj-CS-500.3	2	-	-	-	-	-	2	1	2	3	2	3	1	2	3
Proj-CS-500.4	1	-	-	-	-	-	2	1	3	3	2	3	1	2	2
Proj-CS-500.5	2	-	-	-	-	-	2	2	3	2	2	3	2	-	3
Proj-CS-500.6	1	-	-	-	-	-	2	2	3	2	2	3	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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DTI -500: Design, Thinking and Innovation -III

Periods/week Credits Max. Marks : 50
L:0 T:1 P:0 2 Continuous Assessment : 50

Pre-requisites: Design, Thinking and Innovation -II (DTI-400)

Course Type: HSMC

Course outcomes
The students will be able to**:**

DTI – 500.1 Understand the Plagiarism / Feasibility tools
DTI – 500.2 Document the outcome as Research Paper / Patent / Product / Start-up /copyright

Activity 1:

1.1 Compilation / Documentation of the outcome (Research Paper / Patent / Product / Start-up /copyright).
1.2 Plagiarism / Feasibility check.
1.3 Identification of the suitable Journal / Patenting Agencies / Angel Investors.
1.4 Submission to the identified Journal / Patenting Agencies / Angel Investors.

Course Articulation Matrix:

CO Statement (DTI-500)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
DTI-500.1	-	3	-	-	-	-	-	3	-	-	-	1	-	-
DTI -500.2	-	3	2	3	2	2	2	3	3	3	2	2	3	3

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No.	Parameters	Description	(Marks)
1.	**Attendance**	• Percentage of classes attended by the students	**5**
2.	**Continuous Performance**	• Judge individual student's participation in the Activities • Time bound completion of Activities	**15**
3.	**Accomplishment of the Outcome**	• Quality of the content and results • Acceptance of the outcome (Research Paper/ Patent/ Product/ Copyright) • Report submission / Presentation	**30**

References:

1. www.originlab.com
2. http://www.cambridgesoft.com/software
3. http://www.synergy.com/
4. www.mathworks.com/products/matlab.html

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NAAC 'A' Grade University

BHM-MC-008: Quantitative Aptitude and Personality Development-II

Periods/week	Credits	Max. Marks	: 100
P :2	0	Continuous Evaluation	: 50

Duration of Exam: 2 Hrs End Sem Examination : 50

Pre-Requisite: Basic Knowledge of English, maths and reasoning
Course Type: HSMC

Course Outcomes: Students will be able to-
BHM-MC-008.1. Analyze various forms of data.
BHM-MC-008.2. Solve complex problems based on arithmetic reasoning.
BHM-MC-008.3. Apply short tricks on complex problems of number system.
BHM-MC-008.4. Enhance and expand word knowledge by fostering word consciousness.
BHM-MC-008.5. Construct simple and complex sentences accurately.
BHM-MC-008.6. Develop reading skills & build verbal reasoning skills.

PART – A

Unit 1: Number System II
1.1 Factors and Multiples
1.2 Unit Digits & Cyclicity
1.3 Remainders
1.4 Factorials
1.5 Logarithm

Unit 2: Arithmetic III
2.1 Interest
- 2.1.1 Simple Interest
- 2.1.2 Compound Interest
- 2.1.3 Relation between SI & CI

2.2 Time, Speed & Distance
- 2.2.1 Basics Formulas & Proportionality
- 2.2.2 Average & Relative Speed
- 2.2.3 Trains and Boats & Streams
- 2.2.4 Circular Motion and Clocks

2.3 Data Interpretation
- 2.3.1 Table and Bar graph
- 2.3.2 Line and Pie Charts
- 2.3.1 Mixed Charts and Caselets

Unit 3: Verbal Reasoning III
- 3.1 Calendar
- 3.2 Cubes and Dices
- 3.3 Data Sufficiency

PART – B

Unit 4: Advanced Vocabulary
- 4.1 Synonym & Antonym
- 4.2 One Word Substitution
- 4.3 Ordering of Words
- 4.4 Idioms and Phrases
- 4.5 Vocabulary, COW, Punctuation

Unit 5: Sentence Construction & Syntax
- 5.1 Sentence Improvement
- 5.2 Spotting Errors
- 5.3 Ordering of Sentences
- 5.4 Change of Voice/ Direct & Indirect speech
- 5.5 Completing Statements/Sentences

Unit 6: Reading Comprehension & Reasoning
- 6.1 Strategic Reading, Eliminating Poor Reading Habits
- 6.2 Techniques to increase speed reading, comprehension and recall

6.3 Solving Sample RC Passages
6.4 Closet Test
6.5 Para Jumbles

Text Books/Reference Books:

1. R S Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations, S Chand & Company PvtLtd.
2. R S Aggarwal, 2018, A Modern Approach to Verbal& Non Verbal Reasoning, S Chand & Company Pvt Ltd.
3. R S Aggarwal, An Advanced Approach to Data interpretation, S Chand & Company PvtLtd, latest Edition
4. P.A. Anand, Verbal Ability and Reasoning for Competitive Examinations, Wiley

Instructions for paper setting: Fifty MCQ will be set in total. Twenty five MCQ will be set from Part A and twenty five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix:

CO Statement (BHM-MC-008)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BHM-MC-008.1	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1
BHM-MC-008.2	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1
BHM-MC-008.3	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-
BHM-MC-008.4	1	-	-	1	-	-	-	-	1	3	-	2	1	1	1
BHM-MC-008.5	1	-	-	1	-	-	-	-	1	3	-	2	-	-	1
BHM-MC-008.6	1	2	-	1	1	1	1	1	1	3	1	2	1	1	1

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BHM-520: Entrepreneurship and Startups

Periods/week	Credits	Max. Marks	: 200
L: 2 T: 0	2	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs		End Term Examination	: 100

Pre-requisite: NIL
Course Type: Humanities & Social Science

Course Outcomes: The course will enable the student to-
BHM-520.1. Acquire Entrepreneurialspiritandresourcefulness.
BHM-520.2. Understand theconceptandprocessofentrepreneurship-itscontributionandrole in thegrowthanddevelopmentofindividualsandthenation.
BHM-520.3. Strengthen the skillsofcreationandmanagementofentrepreneurialventure.

Unit1:IntroductiontoEntrepreneurshipandStart–Ups(6 Lectures)
Definition and Traitsofanentrepreneur,Intrapreneurship,Motivation, typesofBusinessStructures,Similarities/differencesbetweenentrepreneursandmanagers.

Unit2:BusinessIdeasandtheirimplementation(6 Lectures)
Discoveringideasandvisualizingthebusiness, Activitymap, BusinessPlan

Unit3:IdeatoStart-up and Management(7 Lectures)
MarketAnalysis–Identifyingthetargetmarket, CompetitionevaluationandStrategydevelopment, Marketingandaccounting, Riskanalysis, Company'sOrganizationStructure, Recruitmentandmanagementoftalent, financialorganizationandmanagement

Unit4:Financing,ProtectionofIdeas and Exit strategies(7 Lectures)
FinancingmethodsavailableforstartupsinIndia, CommunicationofIdeastopotentialinvestors–InvestorPitch, PatentingandLicenses

Text Books/ Reference books/Web references:

1. SteveBlankandBobDorf, 2020, TheStartupOwner'sManual:TheStep-by-StepGuideforBuildingaGreat Company,wiley.
2. Eric Ries, 2011, The Lean Startup: How Today's Entrepreneurs use ContinuousInnovationtoCreateRadicallySuccessfulBusinesses by EricRies, Penguin UK.
3. https://www.fundable.com/learn/resources/guides/startup
4.https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate- structure/
5.https://www.finder.com/small-business-finance-tips
6.https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your- business

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Quiz	20%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Assignments, Sessional and End Semester Examination paper will consist of various difficulty levels to accommodate the different capabilities of students. Assessment should cover all course outcomes and upper limit for lower order skills will be 40% (for knowledge-oriented questions). However, weightage for different cognitive levels in the question papers can vary.

Instructions for paper setting: The paper setter must ensure the coverage of entire syllabus while setting the question papers and mention the learning outcomes across each section to be measured by the examination. Weightage of the sections may vary as per the number of respective lecture hours mentioned in the syllabus.Action verbs should be used from Bloom's Taxonomy while designing question papers.

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
BHM520.1	-	-	-	-	-	-	-	1	2	2	2	2
BHM-520.2	-	-	-	-	-	-	-	1	2	3	2	2
BHM-520.3	-	-	-	-	-	-	-	1	2	3	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-609: CONTAINER ORCHESTRATION AND INFRASTRUCTURE INFORMATION (CC)

Periods/week Credits Max. Marks : 200
L :3 T: 0 3.0 Continuous Evaluation : 100

Duration of Exam: 3 Hrs End Sem Examination : 100

Pre-requisites: Introduction to containers
Course Type: Program Core

Course Outcomes: Students will be able to-

BCS-DS-609.1	Identify importance and benefits of containers in cloud computing and understand container orchestration and know about the available tools.
BCS-DS-609.2	To understand Container Orchestration and its architecture
BCS-DS-609.3	Apply knowledge on container orchestration tool, Kubernetes
BCS-DS-609.4	Analyze storage and scheduling concepts of Kubernetes.
BCS-DS-609.5	Evaluate networking and Pod security in Kubernetes.
BCS-DS-609.6	Design information infrastructure and analyze system cost.

PART-A

Unit 1: Containers in Cloud Computing

1.1 What are Containers; Importance of containers in cloud computing
1.2 Containers Vs. Virtual machines
1.3 Benefits of containers
1.4 Use cases of containers: Microservices, DevOps, Hybrid and multi-cloud, Application modernizing and migration
1.5 Containerization and types of applications

Unit 2: Container Orchestration

2.1 What is container orchestration;
2.2 Need of container orchestration and limitations of Containers Without Orchestration Capabilities;
2.3 Automation and container orchestration;
2.4 Architecture for container orchestration systems;
2.5 How does container orchestration work;
2.6 Container orchestration tools/platforms and environment needed for it.

Unit 3: Container orchestration with Kubernetes(Part-I)

3.1 Kubernetes Cluster Architecture;
3.2 Core Concept of Kubernetes Services;
3.3 ETCD & Controller & API & scheduler;
3.4 Exploring your Cluster;
3.5 Understanding YAML and Kubctl;
3.6 Kubernetes building blocks: Namespaces, Pods, Replication sets, Deployments and Upgrades-Deployments, Rolling Upgrades, Labels and Annotations- Labels, Annotations, Selectors.

PART-B

Unit 4: Container orchestration with Kubernetes(Part-II)

4.1 Kubernetes fundamentals: Services, DNS and name discovery
4.2 common kubectl commands;
4.3 Storage Management: Creating Persistent volume, Persistent Volume Claim, Volume claim policy understanding, Attach storage on deployment;
4.4 Pod Scheduling: Manual Scheduling, Labels and Selectors, Taints and Tolerations, Node Selectors, Node Affinity, DaemonSets, Static Pods, Multiple Schedulers, Configuring Kubernetes Scheduler;
4.5 Resource allocation: Restrict Limit Memory & CPU use, Creating Resource Quota, Creating Limit Quota.

Unit 5: Container orchestration with Kubernetes (Part-III)

5.1 Networking: Network Namespace understanding, Docker Network,
5.2 Deploy Kubernetes Network, Cluster Networking, Pod Networking, Creating Service Network,
5.3 DNS Concept in kubernetes, Ingress System kuberbnetes; Monitoring Kubernetes: Logging and

Monitoring,
5.4 Monitoring Cluster Component, Managing application Logs; Pod Security: Authentication, TLS Introduction, Certificate System kubernetes,
5.5 Creating Certificate, Role base Access Controls, Cluster Role and Role Binding; SCC: Security Constant Conta & Network PolicyImage Security.

Unit 6: Infrastructure Information
6.1 Introduction to the design process for information systems, Models, Information Technology Infrastructure Library (ITIL);
6.2 Complexity of current computing, multiple technologies, multiple vendors, multiple users, e-Waste disposal,
6.3 Toal cost of ownership; Models in IT system design, IT management systems context diagram, patterns for IT system Management;
6.4 Information system costs and benefits, Capital budgeting for information system, Real Options pricing models, Limitation of financial models.

Text Books/Reference Books:
1. Brayden Smith, 2019, Kubernetes: A Step-by-Step Guide to Learn and Master Kubernetes, Independently published.
2. Gupta, It Infrastructure & Its Management, First Edition, Tata McGraw-Hill Education.
3. Nigel Poulton, 2021, The Kubernetes Book, Kindle Edition
4. Gigi Sayfan, 2019, Hands-On Microservices with Kubernetes: Build, deploy, and manage scalable microservices on Kubernetes, Packt Publishing Limited.
5. Hideto Saito, Hui-Chuan Chloe Lee, et al., 2018, Kubernetes Cookbook: Practical solutions to container orchestration, 2nd Edition, Packt Publishing Limited.
6. Marko Luksa, 2018, Kubernetes in Action, Manning Publications.

WebLinks:
1. https://kubernetes.io/docs/concepts/
2. http://www.buyya.com/papers/CloudContainerOrchSPE.pdf
3. https://www.redhat.com/cms/managed-files/cl-oreilly-kubernetes-operators-ebook-f21452-202001-en_2.pdf

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B. Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement (BMA-101)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
BCS-DS-609.1	2	1	2	-	1	-	-	-	-	-	2	1	-	-

BCS-DS-609.2	3	1	3	1	2	-	-	1	1	2	-	2	2	2
BCS-DS-609.3	1	3	3	2	-	-	-	2	2	1	2	1	-	2
BCS-DS-609.4	3	2	2	2	3	-	-	2	2	2	-	-	3	2
BCS-DS-609.5	2	-	2	3	2	-	-	-	1	2	-	-	2	-
BCS-DS-609.6	3	3	2	1	3	-	-	-	-	-	-	2	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-657: CONTAINER ORCHESTRATION AND INFRASTRUCTURE INFORMATION LAB(CC)

Periods/week Credits
P: 2 1.0
Duration of Examination: 2 Hrs

Max. Marks : 100
Continuous Evaluation : 50
End Sem Examination : 50

Co-Requisite: Container Orchestration and Infrastructure Information (CC) (BCS-DS-609)
Course Type: Program Core

Course Outcomes: The students will be able to-

BCS-DS-657.1	Understand the Kubernetes Tool.
BCS-DS-657.2	Analyze the commands and create services. Also able to select applications for deployment.
BCS-DS-657.3	Learn execution of Jobs and Pods.
BCS-DS-657.4	Solve any problem while working with StatefulSets.
BCS-DS-657.5	Learn how to manage Microservices.
BCS-DS-657.6	Synthesize the provisioning of Kubernetes Tool.

List of Experiments:

1. Setting Up Your Workstation
2. Creating Our First Pod.
3. Deploy and Upgrade a Single Service.
4. Creating a Load Balancer Service.
5. Deploying applications using Ingress.
6. Using ConfigMaps and Secrets.
7. Running Jobs and CronJobs.
8. Running Pods as DaemonSets.
9. Deploying Applications using Helm.
10. Configuring Autoscaling.
11. Working with StatefulSets.
12. Managing Microservices with Istio.
13. A Case Study: Kaplan Adopts Containers on AWS, Cutting Costs and Deployment Times
14. **A Case Study:** Weever Apps Enables Development Flexibility Using Amazon VPC and Docker Containers

Text Books/Reference Books:

1 Gigi Sayfan, 2019, Hands-On Microservices with Kubernetes: Build, deploy, and manage scalable microservices on Kubernetes, Packt Publishing Limited.
2. Hideto Saito, Hui-Chuan Chloe Lee, et al., 2018, Kubernetes Cookbook: Practical solutions to container orchestration, 2nd Edition, Packt Publishing Limited.
3.Marko Luksa, 2018, Kubernetes in Action, Manning Publications.

ReferenceBooks/Online Resources:

1. https://kubernetes.io/docs/concepts/
2.http://www.buyya.com/papers/CloudContainerOrchSPE.pdf
3.https://www.redhat.com/cms/managed-files/cl-oreilly-kubernetes-operators-ebook-f21452-202001-en_2.pdf

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

Course Articulation Matrix:

CO Statement (BCS-DS-657)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
BCS-DS-657.1	3	-	1	-	1	-	-	-	2	2	-	-	2	2
BCS-DS-657.2	3	-	-	2	2	-	-	-	1	-	2	-	2	2
BCS-DS-657.3	2	-	3	1	1	-	-	-	1	1	-	-	2	3
BCS-DS-657.4	3	1	3	1	2	-	-	-	1	-	-	2	2	2
BCS-DS-657.5	2	2	3	2	3	-	-	-	2	3	2	2	3	3
BCS-DS-657.6	3	3	2	1	3	-	-	-	-	-	-	2	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-504: BUSINESS INTELLIGENCE (CC, BA)

Periods/week Credits	Max. Marks : 200
L: 3 T: 0 3.0	Continuous Evaluation : 100
Duration of Examination: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Basic knowledge about business in general.
Course Type: Program Core

Course Outcomes: The students will be able to-

BCS-DS-504.2. Understand the basics of Business Intelligence.
BCS-DS-504.3. Learn dashboards design by utilizing key performance indicators that managers can use to improve day-to-day business operations.
BCS-DS-504.4. Identify how to plan and implement BI development projects.
BCS-DS-504.5. Know the administrative and deployment scenarios & issues in BI space.
BCS-DS-504.6. Use analytical skills and business principles in operational and strategic decision-making by means of BI.
BCS-DS-504.7. Design and develop dashboards and learn the best practices to work on BI projects

PART- A

Unit-1: Introduction to Business Intelligence

1.1. Business Intelligence (BI)
1.2. Scope of BI solutions and their fitting into existing infrastructure
1.3. BI Components and architecture, BI Components
1.4. Future of Business Intelligence
1.5. SaaS and Cloud computing techniques

Unit–2: Business Intelligence (Continued)

2.1. Functional areas of BI tools
2.2. End user assumptions
2.3. setting up data for BI
2.4. Data warehouse
2.5. OLAP and advanced analytics
2.6. supporting the requirements of senior executives including performance management
2.7. Glossary of terms and their definitions specific to the field of BI and BI systems.

Unit-3: Elements of Business Intelligence Solutions

3.1 Business Query and Reporting
3.2 Reporting, Dashboards and Scorecards Development
3.3 Development, Scorecards
3.4 Metadata models
3.5 Automated Tasks and Events
3.6 Mobile Business Intelligence
3.7 Software development kit (SDK)

PART- B

Unit-4: Building BI Project

4.1. Stages of Business Intelligence Projects types of inheritance

4.2. Project Tasks
4.3. Risk Management and Mitigation
4.4. Cost justifying BI solutions and measuring success
4.5. BI Design and Development

Unit-5: Report Authoring
5.1. Building Reports
5.2. Building a Report
5.3. Drill-up
5.4. Drill-down Capabilities

Unit-6: BI Deployment, Administration and Security
6.1 Centralized versus Decentralized Architecture
6.2 Phased and Incremental BI road map
6.3 Setting early expectations and measuring the results
6.4 EPM (Enterprise performance Management)
6.5 OLAP Implementation, Implementation
6.6 Data Warehouse Architecture
6.7 Predictive Analysis, Text Mining
6.8 Authentication, Authorization, Access Permissions
6.9 Group and Roles, Single Sign-on (SSO)
6.10 Data Backup and Restoring

Text Books / Reference Books:
1. Business Intelligence, IBM ICE Publication.

Software required/Weblinks:
C/C++(TurboC/DOS BOX)
www. 3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-504)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-504.1	-	-	-	-	-	2	2	2	-	-	3	2	-	2	1
BCS-DS-504.2	2	-	-	-	-	2	-	-	3	2	3	-	-	2	3
BCS-DS-504.3	1	1	2	-	-	-	-	-	-	-	1	-	2	3	-
BCS-DS-504.4	-	2	-	-	2	-	-	-	-	-	-	-	-	2	-
BCS-DS-504.5	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
BCS-DS-504.6	-	2	-	1	2	-	1	-	-	-	-	-	-	2	-

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BCS-DS-553: BUSINESS INTELLIGENCE LAB (CC, BA)

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Business Intelligence (BCS-DS-504)
Course Type: Program Core

Course Outcomes: The students will be able to-
BCS-DS-553.2. Execute Practicals Problems ranging from simple to complex scenarios.
BCS-DS-553.3. Develop their own logic.
BCS-DS-553.4. Design their own authoring reports.
BCS-DS-553.5. Group and summarize data.
BCS-DS-553.6. Learn filtering and grouping of data.

List of Practicals:
Exercise 1 – Exercise 1 - Overview of BI Tool – Cognos Report Studio
Exercise 2 - Authoring Reports
Exercise 3 - List, Crosstab and Chart Reports
Exercise 4 - Grouping and Summarizing data
Exercise 5 - Filter, Sort and Calculation

Software required/Weblinks:
http://www.d1-solutions.com/en/services/business-intelligence-lab/

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**

553)															
BCS-DS-553.1	-	-	-	2	3	-	-	-	-	-	-	-	1	2	-
BCS-DS-553.2	-	1	1	-	-	-	-	-	-	3	-	-	-	-	-
BCS-DS-553.3	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-
BCS-DS-553.4	-	1	1	1	-	-	-	-	-	3	-	-	-	2	-
BCS-DS-553.5	1	-	-	-	2	-	2	-	-	-	-	-	1	2	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BCS-DS-521: COMPUTER GRAPHICS

Periods/week Credits
L: 3 T: 0 3.0
Duration of Examination: 3 Hrs

Max. Marks : 200
Continuous Evaluation : 100
End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-521.1. Describe the basic concept of Computer Graphics, circle Drawing Methods and concept of polygon filling algorithms.
BCS-DS-521.2. Relate the concept of 2-Dimensional primitives, Techniques, viewing pipeline, windows, viewports and Clipping algorithms.
BCS-DS-521.3. Apply 3-Dimensional Graphic & transformation concepts with their matrix representation, 3-D Viewing and projection.
BCS-DS-521.4. Examine curve representation methods, Bezier, B-Spline Curves, Hemite Interpolation method and parametric representation of surface.
BCS-DS-521.5. Validate the concept of hidden surface, the Z- buffer algorithm, scanline algorithm and Area Subdivision algorithm.
BCS-DS-521.6. Formulate the concept of Image, image filtering, image processing, its geometric transformation and image manipulation models.

PART-A

Unit-1: Introduction to Computer Graphics
1.1 Basic concepts of Computer Graphics,
1.2 Computer Graphics Hardware and software,
1.3 Two-dimensional Graphics Primitives: Points, Lines and circles; Line drawing algorithms: DDA, Bresenham's,
1.4 Circle drawing algorithms: Circle drawing using polar coordinates, Bresenham's circle drawing, midpoint circle drawing algorithm,

Unit-2: Two Dimensional Transformation
2.1 Polygon filling algorithms: Scanline algorithm, boundary fill algorithm, flood fill algorithm,
2.2 Two-Dimensional transformations: translation, scaling,
2.3 Rotation, reflection,
2.4 Composite transformations,
2.5 Matrix representation of 2-D transformations,

Unit-3: Viewing and Clipping
3.1 The 2-D viewing pipeline, windows, viewports, window to view port mapping,
3.2 Clipping: point, line, polygon,
3.3 Clipping line algorithms: 4 bit code algorithm, Sutherland-Cohen algorithm, parametric line

3.4 clipping algorithm (Cyrus Beck),
3.5 Polygon clipping algorithm: Sutherland-Hodgeman polygon clipping algorithm,

PART-B

Unit-4: Three Dimensional Transformations and Projections
4.1. Three-Dimensional graphics concepts, Three-Dimensional transformations: translation, scaling,
4.2. Rotation, reflection, composite transformation,
4.3. Matrix representation of 3-D Transformations,
4.4. Three-D Viewing: Projections,
4.5. Types of projections,
4.6. Mathematical formulation of planner geometric projections,

Unit-5: Representing Curves and Surfaces
5.1. Curve representation, Interpolation method to represent a curve,
5.2. Parametric representation of curves: Bezier curves, B-Spline curves and their properties,
5.3. Representation of curves using Hermite Interpolation Method,
5.4. Parametric representation of surfaces using Bezier and B-Spline curves,

Unit-6: Hidden Surface Removal & Image Manipulation
6.1. Concept of hidden surface, detection of hidden surfaces and their removal,
6.2. The Z-buffer algorithm, Scanline algorithm, area sub-division algorithm,
6.3. Concept of Image, Image Filtering, Image processing, geometric transformation of images,
6.4. Image manipulation: Illumination models,
6.5. Shading models for polygons,
6.6. Shadows, transparency.

Text Books / Reference Books:

1. James D. Foley, Andeies van Dam, Stevan K. Feiner and Johb F. Hughes, 1995, Computer Graphics: Principles and Practices, 2nd Edition, Addision Wesley.
2. Donald Hearn and M. Pauline Baker, 1997, Computer Graphics, 2nd Edition, 1997, PHI.
3. David F. Rogers, 2001, Procedural Elements for Computer Graphics, 2nd Edition,TMH.
4. Alan Watt, 2000, Fundamentals of 3-Dimensional Computer Graphics, 3rd Edition,Addision Wesley.
5. Zhigang Xiang Roy Plastock Scham's Outlines Series, 1987, Computer Graphics, 2nd Edition, TMH.
6. Amrendra N Sinha and Arun D Udai, 2008, Computer Graphics 2nd Edition, TMH.

Software Required/Weblinks:
http://www.slideshare.net/SanuPhilip/projection-in-computer-graphics.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures / Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-521)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-521.1	2	3	-	2	2	-	-	-	-	-	-	1	1	-	-
BCS-DS-521.2	2	3	-	3	1	-	-	-	-	-	-	2	1	2	2
BCS-DS-521.3	2	3	1	3	2	-	-	-	-	-	-	1	1	1	2
BCS-DS-521.4	-	-	-	3	2	-	-	-	-	-	-	-	-	1	-
BCS-DS-521.5	2	3	1	-	1	-	-	-	-	2	-	1	1	2	2
BCS-DS-521.6	2	3	1	-	-	-	-	-	-	-	-	-	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BCS-DS-571: COMPUTER GRAPHICS LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Computer Graphics (BCS-DS-521)
Course Type: Program Electives

Course Outcomes: Students will be able to-

BCS-DS-571.1. Define the basic concept of Computer Graphics, circle Drawing Methods, concept of polygon filling algorithms.

BCS-DS-571.2. Generalize the concept of 2-D primitives, transformation Techniques, viewing pipeline, windows, viewports and Clipping algorithms.

BCS-DS-571.3. Apply 3-D Graphic, transformation concepts, Viewing, projection, its types and mathematical formulation.

BCS-DS-571.4. Analyze Bezier Curves, B-Spline Curves, representation of curve using Hemite Interpolation method and parametric representation of surface using Bezier and B- Spline Curve.

BCS-DS-571.5. Synthesize concept of hidden surface, Z- buffer algorithm, scanline and Area Subdivision algorithm.

BCS-DS-571.6. Validate image filtering, image processing, and its geometric transformation and image manipulation models.

List of Programs:

1. Write a program for 2D line drawing as Raster Graphics Display.
2. Write a program for circle drawing as Raster Graphics Display.
3. Write a program for polygon filling as Raster Graphics Display.
4. Write a program for line clipping.
5. Write a program for polygon clipping.
6. Write a program for displaying 3D objects as 2D display using perspective transformation.
7. Write a program for rotation of a 3D object about arbitrary axis.
8. Write a program for Hidden surface removal from a 3D object.
9. Write a program to draw circle and roll it along X axis and Y- axis by removing the previous circle. Also draw a pie-chart for a given dataset.
10. Write a program to draw a 2–Dimensional curve y=2x+4x ,0<= x <=2, and rotate the curve about x-axis and y- axis.
11. Write a program to draw a cylinder the axis along z-axis and then its projection on the plan z=ax+by, for different values of a and b. (Hint: first create a cylinder then color of cylinder for z >=ax+by, to background color).
12. Write a program to draw equilateral triangles and then combine these to draw a regular hexagon and fill up the triangles with different colours.
13. Write a program to interpolate the curve for the following data using cubic (i) Bezier curve (ii) B-Spline functions:

X	1	2	3	4	5	6
Y	10	100	400	1500	4000	9000

14. Write a program to develop the bar chart and growth curves for the following sale data of items A, B and C.

Year	2004	2005	2006	2007	2008
A	500	550	600	700	750
B	700	725	750	800	850
C	600	580	540	500	580

15. Write a program to draw a chessboard with two colours and put (figures such as circle, triangles, and rectangles) in place of objects-of-chess at different positions.

Reference Books:

1. James D. Foley, Andeies van Dam, Stevan K. Feiner and Johb F. Hughes, 1995, Computer Graphics: Principles and Practices 2nd Edition, Addision Wesley.
2. Donald Hearn and M.Pauline Baker, 1997, Computer Graphics 2nd Edition, PHI.
3. David F. Rogers, 2001, Procedural Elements for Computer Graphics, 2nd Edition, TMH.
4. Alan Watt, 2000, Fundamentals of 3Dimensional Computer Graphics,3rd Edition,Addision Wesley.
5. Zhigang Xiang Roy Plastock Scham's Outlines Series, 1987, Computer Graphics ,2nd Edition,TMH.
6. Amrendra N Sinha And Arun D Udai, 2008, Computer Graphics 2nd Edition,TMH.

Software Required/Weblinks:
http://www.slideshare.net/SanuPhilip/projection-in-computer-graphics.

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-571)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-571.1	1	3	-	2	-	-	-	-	-	-	-	1	1	1	-
BCS-DS-571.2	1	3	-	3	1	-	-	-	-	-	-	2	-	2	2
BCS-DS-571.3	1	3	-	3	2	-	-	-	-	2	-	1	-	1	2
BCS-DS-571.4	1	2	-	3	2	-	-	-	-	-	-	2	1	1	3
BCS-DS-5715	1	3	1	2	1	-	-	-	-	-	-	1	2	2	2
BCS-DS-571.6	1	1	1	-	-	-	-	-	-	-	-	2	1	1	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BCS-DS-474A : Java Programming

Periods/week Credits	Max. Marks : 200
L : 3 T:0 3.0	Continuous Evaluation: 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: NIL

Course Type: Elective

Course Outcomes: The students will be able to-
BCS-DS-474A.1. Explain intermediate level Java programs.
BCS-DS-474A.2 Analyze the efficiency, in terms of lines-of-code, of O-O programming using the containers.
BCS-DS-474A.3 Demonstrate O-O inheritance and polymorphism by using the concept of Abstract Methods & Interfaces and controlling the scope of a variable or method.
BCS-DS-474A.4 Implement exception handling in Java programs.
BCS-DS-474A.5 Design GUI components onto a computer screen to respond to events such as a mouse click or the push of a button and database connections of GUI components.
BCS-DS-474A.6 Create files and read from computer files using Java.

PART-A
Unit-1: CORE JAVA
1.1 Introduction to Java, Data types,
1.2 Variables, operators, Arrays.
1.3 Control Statements, Classes & objects
1.4 Object constructors
1.5 Packages
1.6 Inheritance, Classes, Superclass, subclass
1.7 Interfaces & Inner Classes
Unit-2: Applications & Applets
2.1 JAR files, Applets, its life cycle
2.2 Accessing image & audio files
2.3 Classification of exception, Exception handling
2.4 Logging, log manager configuration, logging handlers & filters
Unit-3:AWT
3.1 Graphic Programming, creating frames
3.2 Positioning and display of information
3.3 2-D shapes & use of colors Fonts
3.4 Event Handling-buttons

3.5 Action Events, Mouse events, User Interface Components with swings
3.6 Design pattern, layout Management, text inputs
3.7 Choice components, menus, dialog Boxes, Images.
PART-B
Unit-4: Distributed Objects
4.1 The Roles of Client and Server
4.2 Remote Method Invocations, Setup for Remote Method Invocation
4.3 Parameter Passing in Remote Methods Server Object Activation, Java IDL and CORBA
4.4 Remote Method Calls with SOAP.

Unit-5 Multithreading & File Handling
5.1 Threads, lifecycle
5.2 Interrupting threads, thread properties
5.3 Synchronization, Blocking queues
5.4 Threads & Swings: I/O streams, Sequential File Access, Random File Access.
Unit-6: Database
6.1 The Design of JDBC. The Structured Query Language, JDBC Installation 6.2 Basic JDBC Programming Concepts, Query Execution
6.3 Scrollable and Updateable Result Sets
6.4 Metadata, Row Sets, Transactions.

Text Books / Reference Books:
1. Core JavaTM , Volume I : Fundamentals S. Horstmann, Gary Cornelll,7thEd., 2008 Pearson Education
2. Programming with JAVA: A Primer E. Balaguruswami 4thEd., 2009 Tata McGraw Hill
3. Java: The Complete Reference HebertSchild, C. S, Gray Cornel, 9thEd., 2014 Tata McGraw Hill
4. Professional Java Programming : Brett Spell, 1stEd., 2000, WROX Publication
5. Advanced Java 2 Platform How to Program: H. M. Deitel, P. J. Deitel, S. E. Santry , 2ndEd., 2001, Prentice Hall

Software required/Weblinks:
https://www.tutorialspoint.com/java/
https://www.coursera.org/specializations/java-programming www.w3schools.in/java-tutorial/
Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.
Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX : CO Statement (BCS-DS-474A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
BCS-DS-474A.1	2	-	-	-	-	-	-	-	-	1	-	-	-	-
BCS-DS-474A.2	-	2	1	2	-	-	-	-	-	-	-	-	1	-
BCS-DS-474A.3	-	-	2	-	-	-	-	-	-	2	-	-	-	-
BCS-DS-474A.4	-	-	3	-	2	-	-	-	1	-	-	-	-	2
BCS-DS-474A.5	-	-	2	-	2	1	-	-	-	-	-	-	-	-
BCS-DS-474A.6	-	-	-	-	3	-	-	-	-	-	-	1	-	-

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BCS-DS-572: Dot Net

Periods/week Credits	Max. Marks	: 100
P: 2 1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs	End Sem Examination	: 50

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-

BCS-DS-572.1 Understand the Role of Visual Studio Integrated Development Environment for developing applications under the .Net Framework.

BCS-DS-572.2. Execute the programs with basic Object Oriented Programming Concepts in C# like Class, Object, Data Abstraction, Encapsulation, Polymorphism and Multiple Inheritance through Interfaces.

BCS-DS-572.3. Implement various Console applications to create- Arrays, Strings, .Net Collections, Property, Indexers, Delegates, and implementing Exception Handling.

BCS-DS-572.4. Analyze the basic components for developing Windows based GUI applications, such as designing window forms, using controls, menus and be able to develop Windows application under the .Net Framework.

BCS-DS-572.5. Evaluate the role and features of ADO.NET as a connectivity provider between application and the database.

BCS-DS-572.6. Create simple ASP.NET Web based GUI applications.

List of Practicals:

1. Implement a console application that takes two numbers as input, perform various arithmetic computations (+, -, *, x, /) on operands and displays the result of operations.
2. Implement a console application to display various patterns: like- Triangles and hut of numbers or characters etc.
3. Write a program that takes a decimal number as input and displays its equivalent in binary form.
4. Write a program to display no. of days in a month, today's and yesterday's system date and time using built-in class.
5. Implement a console application to show, how Automatic Fall through is prohibited or permitted in C#, using switch case.
6. Input 1-d array elements. Implement a console application to find the length of an array using

"property" and perform sorting and reversing operations on array elements, using built-in methods of Array class.

7. Display menu for various matrix operations: Addition, Subtraction, Multiplication and transpose. Input two matrices. Write a console application to perform user selected operation.
8. Implement a console application to perform different operations on immutable string objects like copying, concatenating, comparing, inserting a substring, extracting a substring etc. using built-in methods of String class.
9. Implement a console application to perform insert and append operations on mutable string objects.
10. Define a class named-overloading, write a console application to find area of a cube, cylinder and box (using method overloading).
11. Write a program to implement multiple inheritance in c# (using interfaces).
12. Create an Interface named- "Area", write a console application for multiple implementation of an interface through classes- Square, Circle and Rectangle.
13. Implement a console application to invoke multiple methods at runtime (using delegates).
14. Implement a console application to create a property and show how property can control access to fields.
15. Define a class named- fruit. Write a console application to index an "object" of class "fruit" as an array containing fruits names (apple, mango, grapes etc.) as elements (using indexers).
16. Write a program for throwing and handling exception using user defined exception class.
17. Write a program for exception handling with a try, multiple catch and a finally block using system defined exception classes.
18. Implement a console application to create a Stack and Queue collections and display elements (using foreach loop) after performing various operations on the respective collection.
19. Write a console application to create a Hashtable and ArrayList collections and display elements (using foreach loop) after performing various operations on the respective collection.
20. Design a windows based GUI application to create a calculator using windows forms. Use windows controls to input & display the result values.
21. Design a windows based GUI application for creating a "Login Form". Also execute event handler on clicking "submit" buttton at runtime.
22. Develop a windows based SDI application that allows user to make a selection, to calculate factorial of a number and to check for prime number. Design three windows forms, first form presents a choice for selecting a particular operation. The Second form calculates factorial of a number inputted by a user at run time and third form checks, whether a user entered number is prime or not.
23. Develop an ADO.Net based GUI application to retrieve data using Data Reader object from an existing table employee on the SQL server. Design the appropriate GUI to display records in the data grid.
24. Develop an ADO.Net based GUI application for Payroll management to, insert, delete, and update records in the SQL server's tables. Use SQL Command Builder Object.
25. Develop an ASP.Net GUI application that allows user to login on first web page, use appropriate controls to enter their personal information such as name, contact details, academic and college information on second web page and display the entered information on third web page, upon button click- event handling on second web page at run time.
26. Create Students table on SQL server. Design ASP.Net web pages to display student's records of a class. Display fixed number of records on a page and allow the user to navigate to next and previous pages.

Reference Books:

1. E Balagurusamy, 2001, C# Programming,1st Edition, TMH.
2. Julia Case Bradley, 2004, Programming in C#.Net, 1st Edition,TMH.
3. SCHILDT Herbert , 2005, C# 2.0 The Complete Reference, 2nd Edition,TMH.
4. Carles Wright ,2002, C# Tips and Techniques, 1st Edition, TMH.
5. Chris Hart, John Kauffman, David Sussman & Chris Ullman, 2006, Beginning ASP.NET 2.0 with C#, Wrox, Wiley.
6. Bill Evjen, Srinivasa Sivakumar, Devin Rader, Scott Hanselman, Farhan Muhammad, 2005, Professional Asp.Net 2.0,1st Edition,Wrox, Wiley.

Software required/Weblinks:

Microsofts Visual Studio 2008 or above
SQL Server Management Studio 2008 or above

www.c-sharpcorner.com
www.dotnetcurry.com
www.w3resource.com
www.csharp.net-tutorials.com
www.tutorialspoint.com/csharp
www.docs.microsoft.com/en-us/dotnet

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/ Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-572)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-572.1	-	-	2	-	3	1	2	1	2	2	-	-	1	1	1
BCS-DS-572.2	2	1	1	2	3	-	-	2	2	-	-	2	1	2	2
BCS-DS-572.3	2	2	-	2	2	-	1	1	2	-	2	1	2	2	2
BCS-DS-572.4	1	2	2	2	3	2	2	2	3	3	3	3	3	3	2
BCS-DS-572.5	-		2	1	3	-	-	2	3	3	3	2	3	2	2
BCS-DS-572.6	1	1	2	1	3	2	3	2	3	3	3	3	3	3	2

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BCS-DS-573: Visual Basics

Periods/week Credits		Max. Marks : 100
P: 2 1.0		Continuous Evaluation : 50
Duration of Examination: 2 Hrs		End Sem Examination : 50

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-573.1. Interact with the different controls of .Net window applications using visual basic.
BCS-DS-573.2. Design Single and Multiple Document interface.
BCS-DS-573.3. Understand data components.
BCS-DS-573.4. Implement Window based interactive applications.
BCS-DS-573.5. Construct components based on VB.NET.

List of Practical:
1. Design a form such that: in event load, when project runs, the form back color property changed (chose any color).
2. Design a form with three option buttons " red ", " green " and " blue " such that when we click on options the color of the form colored by red, green and blue respectively.
3. Design a form with one text box and three check boxes such that when click on boxes the following is done: change typing to bold, italic, underline.
4. Write a Programme to use Input Box.
5. write a program to move the text (excellent) from textbox to message box and change the color of the text after click on command button (display).
6. Declare x as a constant (P), then compute the area of a circle. Put suitable design.
7. Design a form with menu and a label with a specific title. The menu contains one item color with sub menu items: red, green, blue and exit, to color the label in red, green, blue then exit from the program. Sol: put label1 with any caption for example (hello)
8. write a program to enter the marks of a student then print (pass) if he successful.
9. Write a program to enter two numbers and compute multiplication and division operations using option button with display the phrase (illegal division operation) when the denominator is zero.
10. Design the digital watch using Timer Control.
11. Write a program to find smallest number using array.

12. Write a Program using a list box and combo box.
13. Write a Program to design Menu based application.
14. Write a Program to design SDI and MDI application.
15. Design a Questionnaire or Registration form by using various form controls.
16. Connect with the data base and show database updation operation with the help of suitable GUI
17. Create an Acgtive X control.
18. Miscellaneous experiment
19. Miscellaneous experiment
20. Miscellaneous experiment

Software Required
VB.NET

Reference Books & Weblinks

1. Sheriff, P.D., 2008. Fundamentals of VB. NET. PDR Information Services.
2. MacDonald, M., 2006. The Book of Visual Basic 2005: NET Insight for Classic VB Developers. No Starch Press.
3. file:///C:/Users/ochin/Downloads/VisualBasic_NETNotesForProfessionals.pdf

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-573)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-573.1	2	2	3	-	2	-	-	-	-	-	-	-	2	-	2
BCS-DS-573.2	2	3	-	-	3	-	-	-	-	-	-	-	3	2	2
BCS-DS-573.3	2	2	3	-	3	-	-	-	1	-	-	-	3	-	2
BCS-DS-573.4	2	3	3	3	-	-	-	-	-	-	-	-	-	2	2
BCS-DS-573.5	2	3	-	3	3	-	-	-	2	-	-	2	1	-	2

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BCS-DS-575: Go Language

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-575.1. Formulate the algorithms for simple problems in GO Language
BCS-DS-575.2. Accurate syntax errors as reported by the compilers as well as at run time
BCS-DS-575.3. Define the iterative and recursive approach
BCS-DS-575.4. Understand the various Data structures using Go Language
BCS-DS-575.5. Deploy the Go programming techniques such as pointers, structure and file handling
BCS-DS-575.6. Design the solutions for the real world problems

List of Practicals:
1. Write a program to display your personnel details.
2. Write a program to Generate Multiplication Table using for loop.
3. Write a program to calculate sum of n natural numbers
4. Write a program to swap two numbers without using temporary variables.
5. Write a program to find factorial of a number.
6. Write a program to perform various string functions.
7. Write a program to calculate average of n number using array.
8. Write a program to perform reverse sort function on array.
9. Write a program to perform operation with pointers.
10. Write a program to generate Fibonacci series using recursion.
11. Write a program to access structure members.
12. Write a program to implement bubble sorting.
13. Write a program to implement insertion sorting.
14. Write a program to implement binary search using recursion.
15. Write a program to perform various file operations.

Software required/Weblinks:

Go Language
https://www.golangprograms.com/basic-programs.html
https://www.tutorialspoint.com/go/index.htm
https://www.geeksforgeeks.org/go-programming-language-introduction/

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-575)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-575.1	3	2	3	2	3	2	1	1	2	2	2	2	2	2	2
BCS-DS-575.2	3	3	2	3	2	3	1	2	2	2	1	2	2	2	2
BCS-DS-575.3	3	3	3	2	3	3	2	1	2	2	1	2	2	2	2
BCS-DS-575.4	3	2	3	2	3	2	1	2	2	2	1	2	2	3	2
BCS-DS-575.5	3	3	2	3	3	3	2	2	2	2	1	2	2	3	2
BCS-DS-575.6	3	3	3	3	2	3	2	2	2	3	2	2	2	2	2

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BCS-DS-576: SWIFT

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-576.1. Remember the concept of variables, arrays, string, functions etc.
BCS-DS-576.2. Understand the loops used in swift programming.
BCS-DS-576.3. Apply the concepts learned in application areas.
BCS-DS-576.4. Analyze programming best practices in SWIFT
BCS-DS-576.5. Evaluate app functionality into properly designed components.
BCS-DS-576.6. Create an IOS app from concept to working programs

List of Practicals:
1. Introduction to Swift Programming interface.
2. Write a Swift program to compute and return the absolute difference of n and 51, if n is over 51 return double the absolute difference.
3. Write a Swift program that accept two integer values and return true if one of them is 20 or if their sum is 20.
4. Write a Swift program to add "Is" to the front of a given string. However, if the string already begins with "Is", return the given string.
5. Write a Swift program to test if two given arrays of integers have the same first and last element. Both arrays length must be 1 or more.
6. Write a Swift program to compute the sum of all the elements of a given array of integers and length 4.
7. Write a Swift program to find the larger value of a given array of integers and set all the other elements with that value. Return the changed array.

8. Write a Swift program to draw a HTML string as bold or italic text.
9. Write a Swift program to insert a given string to another given string where the second string will be in the middle of the first string.
10. Write a Swift program to create a new string without the first and last character of a given string. The string length must be at least 2.
11. Write a Swift program that accept two strings of different length and return a string of the form short+long+short. Two given string's length may be 0.
12. Write a Swift program to develop a calculator.
13. Write a Swift program to develop a scientific calculator.
14. Create an application using mobile camera.
15. Develop an application to send a mail on iphone using default configured mail
16. Write a Swift program to read the contents of a file and using default speech to text engine and convert into speech.

Software Required/Weblinks:
swift.org
w3resource.com
www.freewebmentor.com

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-576)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-576.1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BCS-DS-576.2	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-
BCS-DS-576.3	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-
BCS-DS-576.4	-	3	-	-	1	-	-	-	-	-	-	-	-	-	1
BCS-DS-576.5	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-
BCS-DS-576.6	-	-	3	2	2	-	-	-	-	-	-	-	-	3	-

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BCS-DS-577: Kotline

Periods/week Credits	Max. Marks	: 100
P: 2 1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs	End Sem Examination	: 50

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-577.1. Recognize the operation of the application, application lifecycle, intents, and activities.
BCS-DS-577.2. Summarize UI - components, layouts, event handling.
BCS-DS-577.3. Illustrate custom UI elements and positioning.
BCS-DS-577.4. Experiment with broadcast receivers, services, Kotlin APIs for data storage, retrieval, user preferences, files, and databases.
BCS-DS-577.5. Support Live Locations and Menu.
BCS-DS-577.6. Design and deploy his/ her Kotlin application.

List of Practical:
Exercise 1 - Create a Basic Kotlin Application
Exercise 2 - Working with Layouts
Exercise 3 - Kotlin App-Working with Navigation
Exercise 4 – Work with Kotlin Jetpack's library and manage complex lifecycle situation
Exercise 5 - Create an Kotlin App Guess the Word
Exercise 6 - Create an Kotlin App that does distance conversion operations using an options menu
Exercise 7 - Create an Kotlin App that provides distance from your current location to nearest mall on the map
Exercise 8 - Create an Kotlin App that fragments the screen horizontally.
Exercise 9 - Create an Kotlin App that accesses the Bluetooth and camera of your phone.
Exercise 10- Create an Kotlin App that records and plays audio.
Exercise 11- Create an Kotlin App displays the progress of task
Exercise 12- Create an Kotlin Notification App that displays notification about the messages received.

Reference Books:
1. Smyth, N., 2017. Android Studio 3.0 Development Essentials-Android 8 Edition. Payload Media,

Inc..
2. Adelekan, I., 2018. Kotlin Programming By Example: Build real-world Android and web applications the Kotlin way. Packt Publishing Ltd.
3. Obugyei, E.A. and Raman, N., 2018. Learning Kotlin by building Android Applications: Explore the fundamentals of Kotlin by building real-world Android applications. Packt Publishing Ltd.

Software Required/Weblinks:

1. https://developer.android.com/courses
2. https://www.tutorialspoint.com/kotlin/index.htm
3. https://www.javatpoint.com/kotlin-tutorial
4. https://www.w3adda.com/kotlin-android-tutorial

Note: At least 5 programs are to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-577)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-577.1	2	-	-	-	3				1	1		1	2	3	2
BCS-DS-577.2	2	-	3	-	-					2		2	1	2	
BCS-DS-577.3	2	-	-	-	-		3	1		2		2	1	3	1
BCS-DS-577.4	2	2	3	2	-	1	3		1		2			2	
BCS-DS-577.5	2	2	3	-	1	1	2	2	2	3			3	3	3
BCS-DS-577.6	2	2	3	2	2	2		3	3		2			3	2

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BCS-DS-522A: SOFTWARE DEVELOPMENT PROCESSES

Periods/week Credits	Max. Marks : 200
L: 3 T: 0 3.0	Continuous Evaluation : 100
Duration of Examination: 3 Hrs	End Sem Examination :100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-522A.1. Relate the significance of modeling in S/W design USING object-oriented methodologies and the need of iterative S/W design
BCS-DS-522A.2. Comprehend the various techniques used for Model Refinement
BCS-DS-522A.3. Learn and compare the various methodologies used for S/W development.
BCS-DS-522A.4. Examine UML as a tool to design and evaluate the various S/w models. Understand the issues for implementing object-oriented designs or models
BCS-DS-522A.5. Apply the object-oriented approach and use classes, objects, polymorphism etc for project development AND Design and implement object-oriented models using UML appropriate notations
BCS-DS-522A.6. Integrate planning processes used in industry.

PART-A

Unit-1: Introduction
1.1 Review of the Traditional Methodologies
1.2 Advantages of Object Oriented Methodologies over Traditional Methodologies
1.3 Classes, Objects, Encapsulation, Association, Aggregation, Inheritance, Polymorphism, States and Transitions.
1.4 Navigation of class models, Links and association, inheritance, generalizations, aggregation, abstract classes, meta data, Reification, Constraints, Derived data

Visual Modelling using Unified Modelling Language (UML)
1.5 Introduction to Modelling. Object Oriented Modelling concepts
1.6 Introduction to Unified Modelling Language (UML): History of UML
1.7 Overview of UML: Capabilities, Usage of UML. Introduction to Rational Rose
1.8 Rational Rose CASE tool: Capabilities of Rational Rose Case Tool.

Unit-2: Introduction to Object Oriented Software Development Process

2.1 Introduction to OOSD processes. Development stage: Elaboration Stage, Construction Stage, Transition Stage.
2.2 Creating Use Case Diagrams: Actors and Use Cases, Use Case Relationships,
2.3 Types of Relationships,
2.4 Use Case Diagrams: Diagrams in Rational Rose
2.5 Activity Diagrams: Activities, Transitions, Decision Points, Swimlanes
2.6 State diagrams, State diagram behavior, Interaction Modeling:Activity models
2.7 Relationship of Object, Functional and Dynamic Models

Unit-3: Modelling Classes

3.1 Identifying Classes,
3.2 Packages and Drawing Class Diagram
3.3 State, Behaviour, Identity of Objects, Stereotypes and Classes,
3.4 Creating and Documenting Classes in Rational Rose, Packages, Drawing Class Diagram.
3.5 Specifying Relationships: Defining Relationships, Association and Aggregation Relationships,
3.6 Naming Relationships, Role Names, Multiplicity Indicators, Reflexive Relationships,
3.7 Package Relationships, Inheritance, Finding Relationships, Creating Relationships in Rational Rose.

PART -B

Unit-4: Modelling Object Interactions

4.1 Documenting Scenarios using Interaction Diagrams,
4.2 Types of Interaction Diagrams,
4.3 Adding Behaviour and Structure: Representing Behaviour and Structure,
4.4 Creating Attributes & Operations and documenting them, Displaying attributes and operations, 4.5 4.5 Association Classes,
4.6 Analysing Object Behaviour: Modelling Dynamic Behaviour, States.

Unit-5: Model Refinement and iteration planning process

5.1 Revisiting the Model; Making the Model Homogeneous,
5.2 Combining Classes, Splitting Classes, Eliminating Classes,
5.3 Consistency Checking, Scenario Walk-through, Event Tracing, Documentation Review,
5.4 Designing the System Architecture : The need for Architecture, View of Architecture, Logical view, Component View, Process View, Deployment View, Use Case view.
5.5 Benefits, Goals, Design the User Interface,
5.6 Adding Design Classes, The Emergence of Patterns, Designing Relationships,

Unit-6: The Iteration Planning Process

6.1 Benefits, Goals, Design the User Interface,
6.2 Adding Design Classes,
6.3 The Emergence of Patterns, Designing Relationships,
6.4 Designing Attributes and Operations, Designing for Inheritance,
6.5 Coding, Testing, and Documenting the Iteration.

Text Books/ Reference Books:

1. Grady Booch, James Rumbaugh, Ivar Jacobson, 2000, UML User Guide : Addison Wesley.
2. Terry Quatrani 2000, Visual Modelling with Rational Rose 2000 and UML
3. James Rumbaugh, Ivar Jacobson, Grady Booch, 2000, UML Reference Guide : Addison Wesley.
4. Ivar Jacobson, Grady Booch, James Rumbaugh, 1999, The Objectory Software Development Process : Addison Wesley.
5. Maxtin Fowler with Kendall Scott, 2000, UML Distilled : 2nd Ed.

Software Required/Weblinks:

www.tutorialpoint.com/software_engineering
www.rspa.com/spl

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Assessment:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures / Class Performance
End Sem examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-522A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-522A.1	3	2	-	1	-	2	2	-	-	-	-	-	2	3	-
BCS-DS-522A.2	3	-	-	-	3	-	-	-	2	-	3	-	-	2	-
BCS-DS-522A.3	-	2	3	3	-	-	-	-	2	-	3	-	2	2	-
BCS-DS-522A.4	-	3	3	2	3	-	-	-	1	-	2	-	-	-	-
BCS-DS-522A.5	-	1	-	2	-	2	2	-	-	1	3	-	1	2	-
BCS-DS-522A.6	3	-	3	-	2	2	2	-	2	-	2	-	-	3	1

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BCS-DS-578A: SOFTWARE DEVELOPMENT PROCESSES LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Software Development Processes (BCS-DS-522A)
Course Type: Program Electives

Course Outcomes: Students will be able to-

BCS-DS-578A.1. Realize the Software development process and their applications
BCS-DS-578A.2. Understand user interfaces with the use of rational rose
BCS-DS-578A.3. Examine the various diagrams and their relationships
BCS-DS-578A.4. Appraise real- time systems, object and class relationships
BCS-DS-578A.5. Integrate the collaborate objects through implementation
BCS-DS-578A.6. Plan various case studies with real- time scenarios

Teacher(s) is expected to provide at least four Case Studies to the students. The Students are expected to go through the Case Studies, provided to them, thoroughly in the practical class and prepare design documentation using Relational Rose tool. The following are two sample Case Studies.

Case Study-I: University Course Registration System:
At the beginning of each semester, students request a course catalog containing a list of course offerings for the semester. Information about each course, such as professor, Department, etc. will be included to help students make informed decisions. The system allows students to select four courses offering for the semester. In addition to this, each student will indicate two alternative choices in case a course sought offering becomes filled or cancelled. A course offering has to have not more than 10 or less than 3 students. After the registration process is complete, the system sends the information to the billing system so that the student can be billed for the course in the semester.
The professor should be able to access the system to indicate which courses they will be teaching and to see which students are signed up for the course.
A stipulated time period is allowed for the students to change their schedule. Students are allowed to access the system during this time to add/drop/change a course.

Case Study-II: ATM Machine:

The ATM machine for any bank has to be installed at the pre-determined location and loaded with the system software and case etc. The maintenance department is assigned to deal with the modalities regarding the timely maintenance of the machine, trouble shooting, error-correcting, etc. Also the department employs the same mechanism to load the machine with cash every day.
The account holder should be in possession of the ATM Card with correct PIN/Password to access the machine. The ATM machine should validate the entry of each customer using the machine; should check the available balance in the A/c and then only the cash withdrawal should be allowed within the specified range. The system also provides the facilities such as dropping a cheque, taking out balance-amount-slip and its charging should be made payable to the account holder

List of Practical's:

1. Design ATM System Using Structural & Behavioral UML Diagram.
2. Develop Object Model (say) for Processing Examination Data.
3. Design the OOM for Processing issue-function of a Library and develop Object Model and Functional Model. Write codes and test these models with given data.
4. Design use case diagram for Passport Automation System.

5. using the Case Study provided, perform the following practicals.
    - Identify and create the actors for Case Study - I.
    - Provided with the use case of Student Registration and Course Information maintenance. Identify and create 4 more such use cases from Case Study - I.
    - Create the flow of events for any two use cases identified from Case Study- I.
6. Taking Case Study -I as reference, create extend & include relationship between any four use cases identified earlier.
7. Create the main use case Diagram for the Case Study -I.
8. Create the activity Diagram for any two use cases in Case Study -I.
9. Identify and create the objects, classes & Packages for Case Study -II.
10. Create a sequence diagram for any two three objects identified in Case Study -II.
11. Identify and create the communicate association for any five entities in Case Study -II.
12. . Develop OOM for Information System of an Organization. Create Object Model, Functional Model giving a few activities.
13. Develop OOM for various modules for ATM Banking System.
14. Design class diagram for Book bank management system.
15. Design sequence diagram for Hospital management System.
16. Design University Result Management System Using Structural & Behavioral UML Diagram

Reference Books:

1. Wendy Boggs, Michael Boggs, 2002, Mastering UML with Rational Rose
2. Terry Quatrani, Visual Modeling with Rational Rose and UML

Software Required/Weblinks:

ftp://ftp.ics.uci.edu/pub/c2/uml/uml_books_and_tools.html

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-578A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-578A.1	1	-	1	-	-	2	-	-	-	-	-	-	2	-	-
BCS-DS-578A.2		-	1	3	1	2	-	-	1	-	-	1	-	2	-
BCS-DS-578A.3	2	-	1	-	2	-	-	3	-	-	-	-	-	-	-
BCS-DS-578A.4	-	1	1	3	2	-	2	-	-	2	-	-	-	1	3
BCS-DS-578A.5	-	-	1	-	-	2	-	-	-	1	3	-	-	1	3
BCS-DS-578A.6	1	-	2	3	-	3	-	-	-	-	-	-	-	1	3

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BCS-DS-523: MANAGEMENT INFORMATION SYSTEMS

Periods/week Credits	Max. Marks	: 200
L: 3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-523.1. Describe the concepts and need of Information system.
BCS-DS-523.2. Classify the information and methods of information collection.
BCS-DS-523.3. Apply the architecture of data models as per the different modules of information system.
BCS-DS-523.4. Demonstrate the decision support system.
BCS-DS-523.5. Evaluate the strategic policies for the organization.
BCS-DS-523.6. Develop security policies and manage risk in Information system.

PART –A

Unit-1: Introduction to Management Information System (MIS)
1.1. Concept of Information system, Emergence of MIS, Basic Components of MIS,
1.2. Organizational-sectors using MIS: Service sector, Production sector, Business sector; their functional
1.3. models related to MIS;
1.4. Organizing Software support for MIS:
1.5. Need of Automated MIS, Organising Computer Setup and Computer Hardware & Software;
1.6. Role of DBMS, Data Warehouse and Data Mining in MIS.

Unit-2: MIS System-Design
2.1. Information Concepts,
2.2. Information as quality product; Classification of information; Methods of data and information collection, General model of information processing.
2.3. MIS Software and MIS Team. Design of MIS as a System. Design of Modules, Layouts and inputs/outputs, Customization of MIS software for the organization.

Unit-3: Development of MIS

3.1. Long range plan for MIS, Classification of Information requirements at various levels in the organization.
3.2. Architecture of MIS, Detail Design of MIS; System Controls, types of controls; incorporating Management views into the system.
3.3. Development, implementation and testing of MIS. Staff training and functional manuals, scheduling of activities, Reporting System and reporting specifications.

PART –B

Unit-4: MIS as Decision Support System and Strategy Planning
4.1. Role of MIS in Decision making;
4.2. Concept of decision support system (DSS): DSS as deterministic system,
4.3. DSS models and their working.
4.4. Strategic management of organization, Strategic planning and tools of planning, Transforming strategies into MIS activities.

Unit-5: MIS for Service Sector and Business Environment
5.1. Identification of work domain of service sector,
5.2. Objective of MIS in service sector creating MIS as distinctive service, various activities of service sector into MIS; Developing procedures, manuals and documents.
5.3. Overview of applications of MIS to Electronic Business System, Enterprise Business System and Supply Chain Management System.

Unit-6: Security and Ethical Challenges
6.1. Security considerations; Security, ethical and societal challenges of IT;
6.2. Privacy issues; Security of Management of Information Systems.

Text Books / Reference Books:
1. J. A, Marakas G.M. and Behl, M, 2008, Management Information Systems, I edition, TMH.
2. Robert G. Murdick, Loel E. Ross & James R. Claggett, 2010, Information System for Modern Management, 3rd Edition, PHI
3. W. S. Jawadekar, 2002 Management Information System, I edition, Tata McGraw Hill.

Software required/Weblinks:
https://www.slideshare.net/HarishChand5/management-information-system
https://www.tutorialspoint.com/management_information_system/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**

523)															
BCS-DS-523.1	-	1	-	-	-	-	-	-	-	-	-	-	1	2	3
BCS-DS-523.2	1	-	-	-	-	2	-	-	-	-	-	-	1	3	-
BCS-DS-523.3	-	3	3	-	-	-	2	-	-	-	-	-	1	3	-
BCS-DS-523.4	1	-	3	-	-	2	-	-	1	2	-	-	1	2	2
BCS-DS-523.5	-	2	-	1	-	-	1	-	-	-	1	1	2	-	3
BCS-DS-523.6	1	2	3	-	-	-	3	2	2	-	2	2	1	2	3

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BCS-DS-524: Knowledge Based Systems

Periods/week Credits — Max. Marks : 200
L: 3 T: 0 3.0 — Continuous Evaluation : 100
Duration of Examination: 3 Hrs — End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-524.1. Discuss the typical approaches used in AI problem Solving.
BCS-DS-524.2. Compare and contrast various Knowledge representation systems.
BCS-DS-524.3. Understand and apply the mechanism of reasoning and inference in real life problems.
BCS-DS-524.4. Apply the concepts of genetic algorithm and neural network in problem solving.
BCS-DS-524.5. Discover various application areas and understand the concept.
BCS-DS-524.6. Solve and address practical problems in multiple domains.

PART- A

Unit-1: Introduction and Problem Solving
1.1 Introduction to AI,
1.2 Introduction to Knowledge Based Systems
1.3 Problem definition, Formulation
1.4 Problem solving Agents
1.5 State Space search, Search based Problem solving
1.6 Knowledge based problem solving

Unit-2: knowledge Representation and Reasoning
2.1 Prepositional and Predicate Logic
2.2 Production Rules
2.3 Semantic Net, Frames,
2.4 Fuzzy Logic, statistical techniques for determining probability methodologies for developing KBS
2.5 The KBS development life cycle, Knowledge acquisition/elicitation,
2.6 Management of KBS projects,

Unit-3: Planning and Learning

3.1 Planning and Understanding,
3.2 Reasoning, Analogical Reasoning,
3.3 case based Reasoning, common sense reasoning,
3.4 Learning, Learning-by-example, learning-by-doing,
3.5 Explanation based Learning,
3.6 Inference.

PART –B

Unit-4: Neural Networks and Genetic algorithm
4.1 Neural Networks, Architecture
4.2 Hopfield Network, Multi-layer perception,
4.3 Feed forward, Back propagation,
4.4 Genetic Algorithms: Concepts, population, chromosomes, operators,
4.5 Schemata, coding.

Unit-5: Machine Learning
5.1 Clustering,
5.2 Rough sets and Decision Tree,
5.3 Monte Carlo based Feature Selection
5.4 Statistical validity and significance of Models
5.5 Advanced Network Models.

Unit-6: Applications
6.1 Natural Language Processing,
6.2 Machine Vision and Robotics,
6.3 Data Mining and Intelligent Business Support
6.4 Internet based application

Text Books / Reference Books:

1. Japang, M., MacDonell, R., Yoag, A. and Hwa, M.A.C., Rationalized Knowledge-based System and Knowledge based network in SMEs Operations.
2. Russell, S.J. and Norvig, P., 2016. Artificial intelligence: a modern approach. Malaysia; Pearson Education Limited,
3. Goldberg, D.E., 1989. Genetic Algorithms in Search. Optimization and Machine Learning. Addism1—Wesley. Reading, MA.
4. Michalski, R.S., Bratko, I. and Kubat, M. eds., 1998. Machine learning and data mining: methods and applications (Vol. 388). New York: wiley.
5. Jackson, P., 1990. Introduction to expert systems/Peter Jackson.
6. Zimmermann, H.J., 2012. Fuzzy sets, decision making, and expert systems (Vol. 10). Springer Science & Business Media.

Software required/Weblinks:
www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials

Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-524)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-524.1	3	3	3	2	2	2	2	1	2	2	2	2	2	3	3
BCS-DS-524.2	3	2	2	2	2	3	3	2	3	2	3	3	2	2	3
BCS-DS-524.3	2	1	2	1	3	2	1	1	2	1	2	2	2	3	2
BCS-DS-524.4	1	2	3	3	2	1	1	1	3	1	2	2	3	2	2
BCS-DS-524.5	1	1	1	3	1	2	2	1	2	1	1	3	2	3	3
BCS-DS-524.6	1	1	3	1	3	3	3	2	3	3	1	3	1	3	3

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BCS-DS-525: SYSTEM ANALYSIS AND DESIGN

Periods/week Credits
L: 3 T: 0 3.0
Duration of Examination: 3 Hrs

Max. Marks : 200
Continuous Evaluation : 100
End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-525.1. Relate characteristics of system and system development life cycle.
BCS-DS-525.2. Describe the importance of system planning.
BCS-DS-525.3. Perform object oriented analysis of system.
BCS-DS-525.4. Examine modular, structured design and system performance.
BCS-DS-525.5. Design system testing and its techniques.
BCS-DS-525.6. Interpret system audit , security and various types of threats associated with the system.

PART- A

Unit-1: Introduction
1.1. Introduction to System definition and Characteristics of system
1.2. Elements of system
1.3. Types Of system
1.4. System Development Life Cycle
1.5. Basis For planning In system analysis
1.6. Role and need of systems analyst ,
1.7. System Planning and Initial Investigation

Unit-2: System Planning
2.1. Data and fact gathering techniques: Interviews, Group communication, Presentations, Site visits.
2.2. Feasibility study and its importance
2.3. Types of feasibility reports
2.4. System Selection plan and proposal Prototyping
2.5. Cost-Benefit and analysis: Tools and techniques

Unit-3: Systems Design and modeling
3.1. System Design Objective
3.2. Logical and physical design
3.3. Design methodologies
3.4. Data flow diagrams
3.5. Common diagramming conventions and guidelines using DFD and ERD diagrams.
3.6. Data Modeling and systems analysis
3.7. Classification of forms: Input/output forms design, User-interface design, Graphical interfaces.
3.8. Introduction to Object Oriented Analysis and design life cycle
3.9. Object modeling: Class Diagrams,
3.10. Dynamic modeling: state diagram, sequence diagramming.

PART-B

Unit-4: Modular and structured design
4.1. Module specifications,
4.2. Module coupling and cohesion,
4.3. Top-down and bottom-up design,
4.4. System Implementation and Maintenance,
4.5. Planning considerations,
4.6. Conversion methods, producers and controls,
4.7. System acceptance Criteria,
4.8. System evaluation and performance,
4.9. Testing and validation,
4.10. Systems qualify Control and assurance,
4.11. Maintenance activities and issues.

Unit-5: System Testing
5.1. Introduction and Objectives Of testing
5.2. Test Plan
5.3. Testing Techniques
5.4. Types of System Tests
5.5. Quality Assurance Goals in System Life Cycle

Unit-6: System Audit and Security
6.1. Computer system as an expensive resource
6.2. Data and Strong media Procedures and norms for utilization of computer equipment,
6.3. Audit of computer system usage,
6.4. Audit trails,
6.5. Types of threats to computer system and control measures
6.6. Disaster recovery
6.7. Contingency planning.

Text Books / Reference Books:

1. Whitten, Bentaly and Barlow, 2008, System Analysis and Design Methods,I edition, Galgotia Publication.
2. Elias M. Award, 2008, System Analysis and Design, I edition, Galgotia Publication.
3. Jeffrey A. Hofer Joey F. George Joseph S. Valacich, 2014, Modern System Analysis and Design, I edition, Addison Wesley.
4. Willam J. Collins, 2003, Data Structure and the Standard Template library, I edition, TMH

Software required/Weblinks:
www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%

Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-525)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-525.1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-
BCS-DS-525.2	-	-	1	2	-	2	-	-	-		-	-	-	3	-
BCS-DS-525.3	-	2	-	3	3	-	2	-	-	2	2	-	-	3	-
BCS-DS-525.4	1	2	-	-	-	2	-	-	-	-	-	-	-	2	2
BCS-DS-525.5	-	2	2	3	3	-	-	-	2	-	2	2	2	-	3
BCS-DS-525.6	2	-	1	-	-	2	2	-	1	1	-	3	-	2	-

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BCS-DS-531: Data Warehouse

Periods/week Credits	Max. Marks : 200
L: 3 T: 0 3.0	Continuous Evaluation : 100
Duration of Examination: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Database Management Systems (BCS-DS-404)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-531.1. Rephrase the concept of Data Warehouse, multidimensional data model, Data cubes .
BCS-DS-531.2. Examine data cubes, data warehouse backend tools, utilities and data preprocessing.
BCS-DS-531.3. Contrast the difference between DBMS and Data Warehouse
BCS-DS-531.4. Analyze the schemas for Multidimensional Database like stars, snowflakes and fact constellation
BCS-DS-531.5. Design three-tier Data Warehouse architecture and the types of OLAP Servers
BCS-DS-531.6. Validate spatial databases, multimedia databases along with time series and sequence data.

PART-A

UNIT 1: Introduction to Data Warehousing
1.1 Key Characteristics of a Data Warehouse, Historical and Transactional data
1.2 OLTP Systems; Differences between OLTP Systems and Data Warehouse:
1.3 Characteristics of Data Warehouse; Functionality of Data Warehouse: Advantages and Applications of Data Warehouse; Advantages,
1.4 Applications: Top- Down and Bottom-Up Development Methodology: Tools for Data warehouse development: Data Warehouse Types.

Unit 2: Planning and Requirements
2.1 Introduction: Planning Data Warehouse and Key Issues: Planning and Project ,
2.2 Management in constructing Datawarehouse,

2.3 Data Warehouse Project; Data Warehouse development Life Cycle, Kimball Lifecycle Diagram,
2.4 Requirements Gathering Approaches: Team organization, Roles, and Responsibilities.

Unit 3: Data Warehouse Architecture and OLAP
3.1 Introductions, Components of Data warehouse Architecture;
3.2 Technical Architectures; Data warehouse architectures: Data warehouse architecture,
3.2 Tool selection: Federated Data Warehouse Architecture,
3.4 Distributed and Virtual Data Warehouses,
3.5 Types of OLAP Servers, Initializing class objects with constructors,
3.6 ROLAP versus MOLAP versus HOLAP
3.7 Distributed and Virtual Data Warehouses,
3.8 Data Warehouse Manager.

PART-B

Unit 4: Dimensional Modeling
4.1 Introduction: E-R Modeling,
4,2 Dimensional Modeling: E-R Modeling VS Dimensional Modeling:
4.3 Data Warehouse Schemas; Star Schema, Inside Dimensional Table, Inside Fact Table, Fact Less Fact Table,
4.4 Granularity, Star Schema Keys: Snowflake Schema: Fact Constellation Schema.

Unit 5: Extract, Transform and Load
5.1 Introduction: ETL Overview or Introduction to ETL: ETL requirements and steps,
5.2 Data Extraction; Extraction Methods, Logical Extraction Methods,
5.3 Physical Extraction Methods: Data Transformation; Basic Tasks in Transformation,
5.4 Major Data Transformation Types: Data loading; Data Loading Techniques: ETL Tools.

Unit 6: Meta-Data Management in Data Warehouse
6.1 Introductions to Metadata: Categorizing Meta data: Meta data management in practice,
6.2 Meta data requirements gathering, Meta data classification,
6.3 Meta data collection strategies: Meta Data Management in Oracle and SAS,
6.4 Tools for Meta data management.

Text Books / Reference Books:

1. Ralph Kimball, dimensional modeling for data warehousing and business intelligence, 3rd Edn,Wiley,2018
2. Arun Pujari, 2010, Data Mining Techniques, 2nd Edition, Orient Black Swan/ Universities Press.
3. Alex Berson, 2004, Data Warehousing, Data Mining and OLTP, 1st Edition, MGH.
4. W.H. Inman, 2005, Building the Data Warehouse, 4th Edition, John Wiley & Sons.
5. W.H Ionhman, C.Klelly, 1993, Developing the Data Warehouses, John Wiley & Sons.
6. Sourav S Bhowmick , Sanjay K Madria , Wee K Ng , Hardcover,2003, Web Data Management, Springer.
7. Pieter Adriaans & Dolf Zantinge, 1997, Data Mining, Pearson,

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance

End Sem examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-531)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-531.1	3	-	2	-	-	-	1	-	-	-	-	1	-	1	-
BCS-DS-531.2	-	2	3	2	-	1	-	1	-	1	1	2	-	-	-
BCS-DS-531.3	3	-	2	-	1	-	-	2	-	-	-	3	-	-	1
BCS-DS-531.4	-	-	-	3	3	-	-	-	1	-	-	-	2	-	-
BCS-DS-531.5	-	2	3	2	2	-	-	1	-	-	-	-	3	-	-
BCS-DS-531.6	-	2	3	2	2	-	-	1	-	-	-	-	3	-	-

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BCS-DS-507: UI/UX

Periods/week Credits	Max. Marks	: 200
L:0 P: 4 2.0	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic knowledge of Graphics and Gaming
Course Type: Program Core

Course Outcomes: Students will be able to-

BCS-DS-507.1: Discuss the appropriateness of potential user interface andexperience design methods such as diary studies, storyboarding, experience design, etc.

BCS-DS-507.2: Describe the issues and challenges to achieving a human-centered design process, especiallywith regard to user experience design

BCS-DS-507.3: Develop an appreciation for the use of storytelling as a means of designing and evaluating userexperience

BCS-DS-507.4: Use, adapt and extend design standards, guidelines, and patterns focusing on user experience

BCS-DS-507.5: Employ selected design methods at a basic level of competence: diary studies, mood boards,storyboarding, sketching, video scenarios, and experience prototyping

BCS-DS-507.6: Create storyboards, video scenarios, and experience prototypes for a small system and plan andperform a real world deployment study of a user experience

List of Experiments:

i. Understanding the fundamentals and principles of UI/UX design.
ii. To study visual elements of user interface design
iii. Web design: Strategy and Information architecture.
Iv .Knowledge of tools and process used in UI/UX design,
v. Real-life design problems through visual design tools and introduction to 6D.

Text Books/ Reference Books:

1. Buxton, B. (2007), Sketching User Experiences. Sketching User Experiences. San Francisco: Morgan Kaufmann. (Amazon)

2. Greenberg, S., Carpendale, S., Marquart, N., and Buxton, B. (2011) Sketching User Experiences: The Workbook. San Francisco: Morgan

1. Designing for Small Screens: Mobile Phones, Smart Phones, PDAs, Pocket PCs, NavigationSystems, MP3 Players, Game Consoles, by Studio 7.5, Zwick, and Schmitz, ISBN-102940373078

Weblinks:

Balsamiq, By Balsamiq Studios (http://balsamiq.com) Axure RP Pro, by Axure Software solutions (http://www.axure.com/InVision App, by InVision (http://www.invisionapp.com

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab

File work/Class Performance

Viva (Question and answers in lab)

End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-507)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BCS-DS-507.1	-	-	-	2	-	-	-	-	1	-	-	-	2	-	-
BCS-DS-507.2	-	-	1	2	-	-	-	-	-	-	-	-	2	-	1
BCS-DS-507.3	-	-	-	2	-	-	-	-	1	-	-	-	1	-	-
BCS-DS-507.4	1	-	-	2	3	-	-	-	-	-	-	-	2	-	1
BCS-DS-507.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
BCS-DS-507.6	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-

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NAAC 'A^{++}' Grade University

BCS-DS-543: Enterprise Java

Periods/week Credits — Max. Marks : 200

L: 3 T: 0 3.0 — Continuous Evaluation : 100

Duration of Examination: 3 Hrs — End Sem Examination : 100

Pre-Requisite: NIL

Course Type:

Course Outcomes: Students will be able to-

BCS-DS-543.1. Identify appropriate use of servlets and implementation of it to real world problems.

BCS-DS-543.2. Develop complex web applications with JSP.

BCS-DS-543.3. Develop skills to write program in contemporary java to handle complex data.

BCS-DS-543.4. Develop skill in implementing EJB with different types of beans.

PART-A

Unit 1: Understanding Java EE and Servelets

1.1. Understanding Java EE: Enterprise Application, java enterprise edition, Java EE Technologies, Java EE evolution, Glassfish server.

1.2. Java EE Architecture, Server and Containers: Types of System Architecture, Java EE Server, Java EE Containers.

1.3. Introduction to Java Servlets: Need for Dynamic Content, Java Servlet Technology, Why Servlets, What Servlets do.

1.4. Servlet API and Lifecycle: Java Servlet API, Servlet Skeleton, Servlet Life Cycle.

1.5. Working With Servlets: Getting Started, Using Annotations Instead of Deployment Descriptor.

1.6. Working with Databases: JDBC, JDBC Architecture, Accessing Database, Servlet GUI and Database Example.

Unit-2 working with Cookies/Session and Files

2.1. Request Dispatcher: Request-dispatcher Interface, Methods of Request-dispatcher, Request-dispatcher Application.

2.2. COOKIES: Kinds of Cookies, use of Cookies, Creating Cookies Using Servlet, Dynamically Changing Colors of a Page.

2.3. SESSION: Sessions, Lifecycle of Http Session, Session Tracking With Servlet API, A Servlet Session Example.

2.4. Working With Files: Uploading Files, Creating an Upload File Application, Downloading Files, Creating a Download File Application.

2.5. Working with Non-Blocking I/O: Creating a Non-Blocking Read Application, Creating the Web Application, Creating Java Class, Creating Servlets, Retrieving the File, Creating index.jsp.

Unit 3: Working with JSP

3.1. Introduction to Java Server Pages: Java Server Pages, Disadvantages of JSP, JSP v\s Servlets, Life Cycle of a JSP Page, How does a JSP function? JSP execution.

3.2. Getting Started With Java Server Pages: Comments, JSP Document, JSP Elements, JSP GUI Example.

3.3. Action Elements: Including other Files, Forwarding JSP Page to another Page, Passing Parameters for other Actions, Loading a Javabean.

3.4. Implicit Objects, Scope And El Expressions: Implicit Objects, Character Quoting Conventions, Unified Expression Language, Expression Language.

3.5. Java Server Pages Standard Tag Libraries: What is wrong in using JSP Scriptlet Tags? How JSTL Fixes JSP, Scriptlet's Shortcomings, Disadvantages of JSTL, Tag Libraries.

PART-B

Unit 4 Introduction to Enterprise Javabeans:

4.1. Enterprise Bean Architecture, Benefits of Enterprise Bean, Types of Enterprise Bean, Accessing Enterprise Beans, Enterprise Bean Application, Packaging Enterprise Beans

4.2. Working With Session Beans: When to use Session Beans? Types of Session Beans, Remote and Local Interfaces, Accessing Interfaces, Lifecycle of Enterprise Beans, Packaging Enterprise Beans, Stateful and Stateless Session Bean, Singleton Session Beans.

4.3. Working with Message Driven Beans: Lifecycle of a Message Driven Bean, Uses of Message Driven Beans, The Message Driven Beans Example.

4.4. Interceptors: Request And Interceptor, Defining An Interceptor, AroundInvoke Method, Applying Interceptor, Adding An Interceptor To An Enterprise Bean, Build and Run the Web Application.

4.5. Java Naming and Directory Interface: Naming Service, Directory Service, Java Naming and Directory interface, Basic Lookup, JNDI Namespace in Java EE, Resources and JNDI, Datasource Resource Definition in Java EE.

Unit 5: JPA and Hibernate

5.1. Persistence, Object/Relational Mapping and JPA: Persistence in Java, Current Persistence Standards in Java, Why another Persistence Standards? Object/Relational Mapping.
5.2. Introduction to Java Persistence API: The Java Persistence API, JPA, ORM, Database and the Application, Architecture of JPA, How JPA Works? JPA Specifications.
5.3. Writing JPA Application: Application Requirement Specifications, Software Requirements, The Application Development Approach, Creating Database And Tables in Mysql, Creating a Web Application, Adding the Required Library Files, Creating a Javabean Class, Creating Persistence Unit [Persistence.Xml], Creating JSPS, The JPA Application Structure, Running The JPA Application.
5.4. Introduction to Hibernate: Hibernate, Why Hibernate, Hibernate, Database and The Application, Components of Hibernate, Architecture of Hibernate, How Hibernate Works?
5.5. Writing Hibernate Application: Application Requirement Specifications, Software Requirements, The Application Development Approach, Creating Database and Tables in Mysql, Creating a Web Application, Adding The Required Library Files, Creating a Javabean Class, Creating Hibernate Configuration File, Adding a Mapping Class, Creating JSPS, Running The Hibernate Application.

Text Books / Reference Books:

1. Java EE 7 for Beginners, "Sharanam Shah, Vaishali Shah", SPD Edition First 2017.
2. Java EE 8 Cookbook: Build reliable applications with the most robust and mature technology for enterprise development, "Elder Moraes" Packt Edition-First, 2018
3. Advanced Java Programming, "Uttam Kumar Roy", Publisher Uttam Kumar Roy, Edition-2015
4. Govind Sesadri, "Enterprise java Computing: Application and Architectures", Cambridge University Publications, 1999

Instructions for paper setting:

Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials

Sessional tests

Surprise questions during lectures/Class Performance

End Sem examination

Course Articulation Matrix

CO Statement (BCS-DS-543)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-543.1	3	3	2	1	3	1	1	1	2	1	1	1	2	1	2
BCS-DS-543.2	2	2	1	2	2	2	1	1	2	2	2	2	1	2	3
BCS-DS-543.3	3	1	3	2	2	3	1	1	2	3	2	1	1	1	3
BCS-DS-543.4	2	1	2	2	3	2	3	1	2	1	1	2	3	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A++' Grade University

BCS-DS-544: REACT JS

Periods/week	Credits	Max. Marks : 200
L : 3 T:0	3.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs		End Sem Examination : 100

Pre-Requisite: NIL
Course Type: Elective
Course Outcomes: Students will be able to-
BCS-DS-544.1 Understand the tool and to create an application
BCS-DS-544.2 Creating an interface and well-structured pages
BCS-DS-544.3 Develop a single –page or mobile applications
BCS-DS-544.4 To creates reusable components for web pages and mobile applications

Part-A

Unit 1- React Js- Introduction,

1.1 React Versions, Features, Benefits, Applications

1.2 ReactJS- Installation, Tool Chain, The Serve Static Server, Babel Compiler, Create React App Tool chain;

1.3 Architecture, Workflow of React Application

Unit 2- React- Creating a React Application

2.1 Using CDN,

2.2 Using Create React App tool, Files and Folders,

2.3 Source code of the application, Customise the code, Run the application,

2.4 Using custom solution, Using Rollup Bundler, Using Parcel bundler.

Unit 3- React- JSX

2.5 Expressions, Functions, Attributes, Expression in attributes;

2.6 Creating a React component, class component, function component;

2.7 Unit React-Styling- CSS style sheet, Inline styling, CSS Modules;

2.8 React-Properties(props)- Create a component using properties, Nested components, Use components, component collection;

Part- B

Unit 4: React-Event Management

1.1 Introduce events in expense manager app

1.2 React- State management- What is state? State management API;

1.3 Stateless component; Create a stateful component

1.4 Introduce state in expense manager app, state management using React Hooks, component life cycle,

Unit 5: API

5.1 Working example of life cycle API,

5.2 Life cycle API in expense manager App, Component life cycle using React Hooks,

5.3 React children property AKA containment, Layout in component, Pagination, Material UI.

5.4 React- HTTP client Programming, Form Programming,

5.5 Routing, Redux, Animation, Testing,

5.6 CLI commands, Building and Deployment, React Examples.

Text Books/ Reference Books:

1. Fullstack React ; The Complete Guide to ReactJS and Friends Anthony Accomazzo, Ari Lerner, Nate Murray, Clay Allsopp, David Gutman, and Tyler McGinnis.

2. The Road to React by Robin Wieruch

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix

CO Statement (BCS-DS-544)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-544.1	3	3	2	1	3	1	1	1	2	1	1	1	2	1	2
BCS-DS-544.2	2	2	1	2	2	2	1	1	2	2	2	2	1	2	3
BCS-DS-544.3	3	1	3	2	2	3	1	1	2	3	2	1	1	1	3
BCS-DS-544.4	2	1	2	2	3	2	3	1	2	1	1	2	3	2	3

BCS-DS-545 : Kubernetes Application Development

Periods/week	Credits	Max. Marks	: 200
L : 3 T:0	3.0	Continuous Evaluation	:100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: NIL
Course Type: Elective
Course Outcomes: The students will be able to-
BCS-DS-545.1 Understand Kubernetes Concepts.
BCS-DS-545.2 Learn the key terminologies and utilize these for deploying containers across a cluster
BCS-DS-545.3 Implement Kubernetes application and secure these applications.
BCS-DS-545.4 Update Kubernetes Applications and apply advanced scheduling.

PART-A

Unit-1: Kubernetes Concepts
1.1 Microservices
1.2 Cloud-native applications
1.3 Introduction to an orchestrator
1.4 Need of Kuberenetes in technical companies
1.5 Need of Kubernetes for user community
1.6 Building First Kubernetes Project

Unit-2: Kubernetes Architecture
2.1 Introduction to Control plane nodes and worker nodes
2.2 Hosted Kubernetes
2.3 Managing Kubernetes, Kubernetes with Docker

Unit-3: Kubernetes Applications
3.1 Creating a containerized app
3.2 Get the Application code and build the container image.
3.3 Host the image on a registry.

PART-B

Unit-4: Running Kubernetes application
4.1 Introduction to Kubernetes cluster
4.2 Verify your kubernetes cluster
4.3 Deploy the app to Kubernetes, connect to the app and clean-up

Unit-5: Core Concepts
5.1 Kubernetes Internals
5.2 Managing pods' computational resources
5.3 Automatic scaling of pods and cluster nodes

Unit-6: Securing the Kubernetes applications
6.1 Securing the Kubernetes API server
6.2 Securing cluster nodes and the network
6.3 Advanced scheduling and Best practices for developing apps

Text Books/ Reference Books:
1. Kubernetes in Action 1st Edition, by Marko Luksa.
2. Quick Start - Quibernets, 2023 Edition, by Nigel Poulton.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%

Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-545)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-545.1	3	3	2	1	3	1	1	1	2	1	1	1	2	1	2
BCS-DS-545.2	2	2	1	2	2	2	1	1	2	2	2	2	1	2	3
BCS-DS-545.3	3	1	3	2	2	3	1	1	2	3	2	1	1	1	3
BCS-DS-545.4	2	1	2	2	3	2	3	1	2	1	1	2	3	2	3

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BCS-DS-546 : Docker Application Development

Periods/week Credits Max. Marks : 200

L : 3 T:0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: NIL
Course Type: Elective
Course Outcomes: The students will be able to-
BCS-DS-546.1. Understand Docker Concepts for building and deploying web applications.
BCS-DS-546.2. Learn the key terminologies and utilize these for deploying containers
BCS-DS-546.3. Implement Docker applications based on multiple containers and secure these applications.
BCS-DS-546.4. Exploit containers to build microservices architecture

PART-A

Unit-1: Introduction to Docker Concepts
1.1 Containers vs Virtual Machines
1.2 Docker and containers
1.3 Docker: A history
1.4 Installation of Docker

Unit-2: Docker applications
2.1 Running your first image, Basic commands
2.2 Working with registries
2.3 Managing Kubernetes, Kubernetes with Docker
2.4 Docker architecture and linking containers

Unit-3: Software Lifecycle with Docker
3.1 Using Docker in development
3.2 Creating a web application using Docker
3.3 Host the image on a registry, image distribution and testing

PART-B

Unit-4: Deploying containers
4.1 Introduction to Docker resources
4.2 Containers, execution options, host services
4.3 Persistent data and production containers

Unit-5: Logging and monitoring
5.1 The default Docker logging, Aggregating logs, Logs from file
5.2 Monitoring and alerting
5.3 Commercial monitoring

Unit-6: Tools and Techniques
6.1 Networking and Service Discovery
6.2 Orchestration, Clustering, and Management
6.3 Security and Limiting Containers

Text Books/ Reference Books:
1. Using Docker- developing and deploying software with containers - by Adrian Mout, O'Reilly.
2. Docker in Action, Second Edition, by Jeffrey Nickoloff, Stephen Kuenzli.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%

Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-546)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-546.1	1	-	2	1	3	1	1	1	2	1	1	1	2	1	2
BCS-DS-546.2	2	2	-	-	-	-	-	1	2	2	2	2	1	2	3
BCS-DS-546.3	3	1	-	-	-	2	-	1	2	3	2	1	1	1	3
BCS-DS-546.4	2	1	-	-	-	-	-	1	2	1	1	2	3	2	3

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BCS-DS-547 : Genomic Data Science

Periods/week Credits	Max. Marks	: 200
L:3 T:0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite:NIL

Course Type: Elective
Course Outcomes: The students will be able to
BCS-DS-547.1: Understand how high-throughput techniques work in genomic analysis.
BCS-DS-547.2: Know the handling different types of genomic data from data preprocessing, quality control and statistical analysis
BCS-DS-547.3: Become familiar with different types of experiment design and corresponding statistical analysis.
BCS-DS-547.4: Able to functionally interpret the findings from genomic data analysis using bioinformatics tools.
BCS-DS-547.5: Understand the Privacy and Confidentiality
BCS-DS-547.6: Able to Understand Tools and Techniques for Genomic Data Sharing.

PART-A

Unit-1: Introduction to basic concepts of genomics, epigenomics, transcriptomics and proteomics
1.1 Genomics, Transcriptomics, and Proteomics – The Basics
1.2 Types of genomics-structural, functional and comparative genomics Principles of Genetics
1.3 Structure, organization and composition of eukaryotic and prokaryotic genomes.
1.4 evolution and structure of mitochondrial genome, mitochondrial diseases; chloroplast genome

Unit-2: Techniques for genomic data analysis
2.1 GTG banding, Fluorescent in situ hybridization (FISH), microarray-based comparative genomic hybridization (aCGH)
2.2 genomic data analysis: Data collection, Data quality check and cleaning, Data processing, Exploratory data analysis and modeling and Visualization and reporting
2.3 Information for Genomic data: RNA, DNA and Proteins
2.4 Genomic Sampling: Collection and Processing of Samples

Unit-3: Genomic Data Handling
3.1 Transport and Storage of Samples
3.2 Generation of Genomic Data
3.3 Handling and Storage of Genomic Data.

PART-B

Unit-4: Feature selection methods and genomic data
4.1 Feature selection methods: Filter methods, Wrapper methods, Embedded methods and Hybrid methods.
4.2 Knowledge discovery from genomic data: Data recording, Data pre-processing, Data analysis and Data visualization and interpretation.

Unit-5: Privacy and Confidentiality
5.1 Privacy Risks in Sharing Human Genomic Data
5.2 Privacy in Emerging Genomic Data Applications
5.3 Data Sharing in Direct-to-Consumer Genetic Testing
5.4 Measuring Privacy Risks in Genomic Data Sharing.

Unit-6: Tools and Techniques for Genomic Data Sharing.
6.1 Introduction of Machine Learning.
6.2 Statistical data analysis with Machine learning.
6.3 Data presentation with Machine learning technique.

Text Books/ Reference Books:
1. Data Science for Genomics- by Amit Kumar Tyagi, Ajith Abraham, 1st Edition , 2022, Elsevier Publication
2. An Introduction to statistical genetic data science, Second Edition, by Melinda C. Mills.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%

Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-547)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-547.1	2	3	1	2	3	2	2	2	2	2	2	2	2	2	2
BCS-DS-547.2	3	2	2	2	2	2	3	3	3	1	3	2	2	2	2
BCS-DS-547.3	2	1	2	1	3	2	2	2	2	2	2	2	3	3	3
BCS-DS-547.4	1	2	3	3	2	1	1	1	1	3	3	2	2	2	3
BCS-DS-547.5	1	1	1	3	1	2	2	2	2	2	2	2	2	3	3
BCS-DS-547.6	1	1	3	1	3	2	3	2	2	1	2	2	1	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A++' Grade University
BCS-DS-594 : Genomic Data Science Lab

Periods/week	Credits	Max. Marks	: 100
L: 2	1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Sem Examination	: 50

Pre-Requisite: NIL
Course Outcomes: The students will be able to
BCS-DS-594.1: Understand how to collect data for Genomic Data Science.
BCS-DS-594.2: Know the functions of Machine Learning.
BCS-DS-594.3: Become familiar with different types of tools used in Machine Learning for Data Processing.
BCS-DS-594.4: Able to Extract the features form different types of data.
BCS-DS-594.5: Understand the Predefined model in Machine Learning for Genomic Data Science.
BCS-DS-594.6: Able to Design a modified model of Machine Learning for Genomic Data Science.

List of Practicals:
1. Identify the Notebooks and google Colabs tools.
2. Introduction to Python Programming – Python Interpreter and InteractiveMode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements
3. Lists, Tuples, Sets, Strings, Dictionary, Modules.
4. Module Loading and Execution – Packages – Making Your OwnModule – The Python Standard Libraries
5. File Path – Opening and Closing Files – Reading and Writing Files –File Position – Exception:
6. Modules: Introduction – Module Loading and Execution – Packages – Making Your Own Module
7. The Python Libraries for data processing,
8. data mining and visualization NUMPY, Pandas, Matplotlib, Plotly
9. Identify different types of Machine Learning Classifier.
10. Read the data for each classifier and perform their implementation.
11. Make a small project for the Genomic Data Science.

Text Books/ Reference Books:

1. Data Science for Genomics- by Amit Kumar Tyagi, Ajith Abraham, 1st Edition , 2022, Elsevier Publication
2. An Introduction to statistical genetic data science, Second Edition, by Melinda C. Mills.

Software Required: Python, Jupiter Notebook and Google Collaboratory.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab

File work/Class Performance

Viva (Question and answers in lab)

End Semester Practical Examination

Course Articulation Matrix:

CO Statement (BCS-DS-594)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

BCS-DS-594.1	2	3	1	2	3	2	2	2	2	2	2	2	2	2	2
BCS-DS-594.2	3	2	2	2	2	2	3	3	3	1	3	2	2	2	2
BCS-DS-594.3	2	1	2	1	3	2	2	2	2	2	2	2	3	3	3
BCS-DS-594.4	1	2	3	3	2	1	1	1	1	3	3	2	2	2	3
BCS-DS-594.5	1	1	1	3	1	2	2	2	2	2	2	2	2	3	3
BCS-DS-594.6	1	1	3	1	3	2	3	2	2	1	2	2	1	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A++' Grade University
BCS-DS-548: GPU Programming

Periods/week Credits Max. Marks : 200
L :3 T: 0 3.0 Continuous Evaluation : 100
Duration of Exam: 3 Hrs End Sem Examination : 100
Pre-Requisites: NIL
Course Type: Elective
Course Outcomes: Students will be able to-
BCS-DS-548.1 Define terminology commonly used in parallel computing, such as efficiency and speedup.
BCS-DS-548.2 Describe common GPU architectures and programming models.
BCS-DS-548.3. Implement efficient algorithms for common application kernels, such as matrix multiplication.
BCS-DS-548.4 Given a problem, develop an efficient parallel algorithm to solve it.
BCS-DS-548.5 Given a problem, implement an efficient and correct code to solve it, analyze its performance, and give convincing written and oral presentations explaining the achievements.

PART - A

Unit 1: GPU ARCHITECTURE
1.1 Introduction: History, GPU Architecture,
1.2 Clock speeds, CPU / GPU comparisons, Heterogeneity,
1.3 Accelerators, Parallel Programming, CUDA OpenCL / OpenACC,
1.4 Kernels Launch parameters, Thread hierarchy, Warps/Wavefronts, threadblocks/Workgroups,
1.5 Streaming multiprocessors,1D/2D/3D thread mapping,
1.6 Device properties, Simple Programs

Unit 2: Memory
2.7 Memory hierarchy, DRAM / global, local / shared, private / local, textures,
2.8 Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory,
2.9 Multi-dimensional Arrays, Memory Allocation,
2.10 Memory copying across devices,
2.11 Programs with matrices, Performance evaluation with differentmemories.

Unit 3: Synchronization

3.5 Memory Consistency, Barriers (local versus global), Atomics, Memory fence.
3.6 Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists.
3.7 Synchronization across CPU and GPU.
3.8 Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

PART - B

Unit 4: OPENCL BASICS

4.1 Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects.

4.2 Streams: Asynchronous processing, tasks, Task-dependence,
4.3 Overlapped data transfers, Default Stream, Synchronization with streams.
4.4 Events, Event-based- Synchronization - Overlapping data transfer and kernel execution, pitfalls.

Unit 5: Case Studies
5.1Image Processing,
5.2 Graph algorithms,
5.3 Simulations,
5.4 Deep Learning

Unit 6: Advanced topics
6.1 Dynamic parallelism,
6.2 Unified Virtual Memory,
6.3 Multi-GPU processing,
6.4 Peer access,
6.5 Heterogeneous processing

TEXT BOOKS:

1. Shane Cook, CUDA Programming: —A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, —Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015.

REFERENCES:

1. Nicholas Wilt, —CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison – Wesley, 2013.
2. Jason Sanders, Edward Kandrot, —CUDA by Example: An Introduction to General Purpose GPU Programming, Addison – Wesley, 2010.
3. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors – A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.
4. http://www.nvidia.com/object/cuda_home_new.html
5. http://www.openCL.org

Instructions for paper setting:

Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-548)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**

BCS-DS-548.1	3	2	1	2	2	3	2	1	2	2	2	3	2	2	3
BCS-DS-548.2	3	2	2	2	2	3	3	2	3	2	3	3	3	3	2
BCS-DS-548.3	2	1	2	1	2	2	1	1	3	1	3	3	3	2	2
BCS-DS-548.4	1	3	2	2	3	1	1	1	2	1	2	2	2	2	3
BCS-DS-548.5	1	3	2	2	3	1	1	1	2	1	2	2	2	2	3

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NAAC 'A' Grade University

HM-506 : French-1

Periods/week Credits		Max. Marks	: 100
L: 2 T: 0 2.0		Continuous Evaluation	: 50
Duration of Examination: 1.5 Hrs		End Sem Examination	: 50

Pre-Requisite: Basic knowledge of grammatical structure, syntax, and vocabulary of English and/or Hindi.
Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-

HM-506.1. Exchange greetings and do introductions using formal and informal expressions. They can understand and use interrogative and answer simple questions.

HM-506.2. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greeting, weather and daily activities,) with repetition when needed.

HM-506.3. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.

HM-506.4. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary. Provide basic information about familiar situations and topics of interest.

HM-506.5. Express or/and justify opinions using equivalents of different verbs. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture.
HM-506.6. Describe various places, location, themselves using simple sentences and vocabulary.

PART-A

Unit 1- Saluer et épeler l'alphabet
1.1 Les Salutations & forms of politeness
1.2 Alphabets

Unit 2- Usage de Vous et de Tu
2.1 Taking leave expressions
2.2 Les pronoms sujets
2.3 Basic Questions

Unit 3- Présentez-vous
3.1 Les verbes ER
3.2 Self introduction
3.3 Décrivez votre ami(e)

PART-B

Unit 4- Identifier un nombre, compter
4.1 Les noms
4.2 Verbes Avoir, Etre, Aller & Faire
4.3 Les nombres

Unit 5- Demander/ donner l'explications
5.1 Les articles define et indefini
5.2 Les mois de l'annee
5.3 Les jours de la semaine

Unit 6- Parler des saisons et demander l'heure
6.1 Time
6.2 Weather
6.3 Unseen Passage

Text Books/Reference Books/ Suggested Readings:

1. Alter Ego Level One Textbook: Annie Berthet, Catherine Hugot, Veronique M Kizirian, 2006, Hachette Publications.
2. Apprenons Le Francais II & III: Mahitha Ranjit, 2014, Saraswati Publications.

Weblinks:
www.bonjourfrance.com
www.allabout.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores
Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM–506)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
HM-506.1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-506.2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-506.3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-506.4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-506.5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-506.6	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1

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HM-507 : German-1

Periods/week Credits	Max. Marks	: 100
L: 2 T: 0 2.0	Continuous Evaluation	: 50
Duration of Examination: 1.5 Hrs	End Sem Examination	: 50

Pre-Requisite: Basic knowledge of grammatical structure, syntax, and vocabulary of English and/or Hindi.
Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-
HM-507.1. Exchange greetings and introductions using formal and informal expressions. They will be able to ask and answer simple questions.
HM-507.2. Discuss everyday life and daily routines, using simple sentences and familiar vocabulary.
HM-507.3. Identify key details in short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed.
HM-507.4. Discuss likes and dislikes, understand simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed
HM-507.5. Differentiate certain patterns of behavior in the cultures of the German- speaking world and the student's native culture.
HM-507.6. Describe various places, location, themselves using simple sentences and vocabulary.

PART-A

Unit-1: Begrüßungen
1.1 Salutations/Greetings
1.2 Introduction

Unit-2: sich vorstellen und Zahlen
2.1 Introduction
2.2 Alphabets
2.3 Numbers 1-20

Unit-3: Berufe/ Pronomen
3.1 Personal pronouns
3.2 Hobbies and professions

PART-B

Unit-4: Café
4.1 Café related vocabulary and dialogues
4.2 Revision personal pronouns

Unit-5: Café dialog
5.1 Café related vocabulary and dialogues
5.2 Common verbs and their conjugations

Unit-6: Zeit und Monate
6.1 Time
6.2 Days
6.3 Months

Text Books/Reference Books:

1. Studio D A1: Hermann Funk, 2011, Cornelson Publication.
2. Tangaram Aktuell A1: Kursbuch & Arbeitsbuch, 2011, Hueber.
3. Netzwerk: Stefanie Dengler, Paul Rusch, 2011, Klett.

Weblinks:
http://www.nthuleen.com/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores
Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM–507)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HM-507.1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-507.2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-507.3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-507.4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-507.5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-507.6	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1

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HM-508 : Spanish-1

Periods/week Credits	Max. Marks : 100
L: 2 T: 0 2.0	Continuous Evaluation : 50
Duration of Examination: 1.5 Hrs	End Sem Examination : 50

Pre-Requisite: Basic knowledge of grammatical structure, syntax, and vocabulary of English and/or Hindi.
Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-

HM-508.1. Exchange greetings and introductions using formal and informal expressions and students will be able to ask and answer simple questions.

HM-508.2. Discuss everyday life and daily routines, using simple sentences and familiar vocabulary and students will be able to discuss likes and dislikes understand simple conversations about familiar topics.

HM-508.3. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed and students will be able to offer basic descriptions of self, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.

HM-508.4. Provide basic information about familiar situations and topics of interest and students will be able to express or/and justify opinions using equivalents of different verbs.

HM-508.5. Differentiate certain patterns of behavior in the cultures of the Spanish-speaking world and

student's native culture.
HM-508.6. Describe various places, location, themselves using simple sentences and vocabulary.

PART-A

Unit 1: Introduction to Spanish and SER
1.1 Presentation on Spanish language
1.2 Greetings and goodbyes
1.3 Spanish letters
1.4 Introduction of Verbo SER

Unit 2: Verb Ser, Nationality, Profession and Counting
2.1 Uses of Verbo SER
2.2 Adjectives related to Verbo SER.
2.3 Introduction of Nationality
2.4 Professions and vocabulary related to professions.
2.5 Counting till number 20.

PART-B

Unit 3: Articles, Interrogative and Estar
3.1 Introduction of Articles and Indefinite articles
3.2 Interrogatives
3.3 Introduction of Verbo Estar

Unit 4: Estar, Preposition, Tener and Self Introduction
4.1 Uses of Verbo ESTAR and adjectives related to it
4.2 Prepositions related to the positioning of an object
4.3 Tener & its uses
4.4 Self – introduction

Unit 5 : Day, Month and Regular AR verb
5.1 Days
5.2 Months
5.3 Introduction to regular –AR verbs

Text Books/Reference Books:

1. Spanish Grammar: Eric V Greenfield, 1971, Barnes and Noble.
2. Nuevo Espanol sin fronteras 1 + Workbook + CD: Jesus Sanchez Lobato and Isabel Santos Gargallo, 2006, Goyal, Ele & Sgel.

Weblinks:
http://studyspanish.com/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores
Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM-508)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

HM-508.1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-508.2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-508.3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-508.4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-508.5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
HM-508.6	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1

SEMESTER – VI

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PROJ-CS-600: Project-I

Periods/week Credits Max. Marks : 50
P: 2 1.0 Continuous Evaluation : 50
Duration of Examination: 2 Hrs

Pre-Requisite: Basic Knowledge of computers
Course Type: Projects

Course Outcomes: Students will be able to-
PROJ-CS-600.1. Conceptualize real world situations related to systems development decisions, Originating from source requirements and goals.
PROJ-CS-600.2. Identify various computing tools.
PROJ-CS-600.3. Identify their area of interest and do extensive literature survey on the same.
PROJ-CS-600.4. Design models as a solution for particular problems.
PROJ-CS-600.5. Implement basic solutions in various platforms
PROJ-CS-600.6. Prepare a summarized report in the form of synopsis.

Text Books / Reference Books:
1. Harold Kerzner, 2013, Project Management: A Systems Approach to Planning, Scheduling, and Controlling; 11th edition, WILEY.
2. Adrienne Watt, 2008, Project management; BC Open Text book.

Software required/Weblinks:
Ieee.org
www.neptal.com

Distribution of Continuous Evaluation:

Presentation/Viva	40%
Report	20%
Class Work/ Performance	20%
Attendance	20%

Evaluation Tools:
Presentation/Implementation

COURSE ARTICULATION MATRIX:

CO Statement (PROJ-CS-600)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
PROJ-CS-600.1	-	-	-	2	-	3	3	1	-	-	-	-	-	-	-
PROJ-CS-600.2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
PROJ-CS-600.3	-	2	-	1	-	-	-	-	-	-	-	-	-	-	3
PROJ-CS-600.4	-	-	3	-	-	-	-	-	-	-	1	-	-	-	-
PROJ-CS-600.5	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-
PROJ-CS-600.6	-	-	-	3	-	-	-	3	2	-	2	2	-	-	-

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BHM-MC-009: Quantitative Aptitude and Personality Development-III

Periods/week	Credits	Max. Marks	: 100
P :2	0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Sem Examination	: 50

Pre-Requisite: Basic Knowledge of maths and reasoning
Course Type: HSMC

Course Outcomes: Students will be able to-
BHM-MC-009.1. Recognize problem based on Modern Mathematics and Algebra
BHM-MC-009.2. Solve basic to moderate level problems based on Mensuration and Geometry.
BHM-MC-009.3. Calculate solution to logical reasoning.
BHM-MC-009.4. Get proficient with resume building and will be able to draft effective cover letters.
BHM-MC-009.5. Participate effectively and confidently in a Group Discussion
BHM-MC-009.6. Manage interviews effectively.

PART – A

Unit 1: Modern Mathematics and Algebra
1.1 Permutation and Combination
1.1.1 Principal of counting and Basic formulas
1.1.2 Arrangements, Selection and Selection + Arrangement.

1.1.3 Linear/Circular arrangements, Digits and Alphabetic Problems and Applications.

1.2 Probability

1.2.1 Events and Sample Space, Basic Formulas.
1.2.2 Problems on Coins, Cards and Dices.
1.2.3 Conditional Probability, Bayes' Theorem and their Applications.

1.3 Algebra

1.3.1 Linear & Quadratic equations
1.3.2 Mathematical inequalities
1.3.4 Maximum & Minimum Values
1.3.3 Integral Solutions

Unit 2: Geometry and Mensuration

2.1 Geometry

2.1.1 Basic geometry & Theorems, Lines & Angles
2.1.2 Polygons, Triangle and Quadrilaterals
2.1.3 Circles

2.2 Mensuration I- Areas

2.2.1 Different types of Triangles and their area and perimeter.
2.2.2 Different types of Quadrilateral and their area and perimeter.
2.2.3 Circumference and Area of Circle, Area of Sector and length of Sector.
2.2.4 Mixed Figures and their Applications.

2.3 Mensuration II- Surface Areas and Volumes

2.3.1 Problems on Cubes & Cuboids, Cone, Cylinder and Sphere.
2.3.2 Prism and Pyramid.
2.3.3 Mixed Figures and their Applications.

Unit 3: Logical Reasoning

3.1 Linear Arrangement
3.2 Circular Arrangement
3.3 Puzzles

Part - B

Unit 4: Professional Writing

4.1. Profiling on Social Sites: LinkedIn, Facebook, Instagram
4.2. Cover Letter/Emails
4.3. Resume Writing

Unit 5: Group Discussions

5.1. Do's and Dont's of a Group Discussion
5.2. Roles played in a Group Discussion
5.3. Tips for Cracking a Group Discussion

Unit 6: Managing Interviews

6.1. Developing the employability mindset
6.2. Preparing for Self -Introduction
6.3. Researching the employer
6.4. Portfolio Management
6.5. Answering Questions in an Interview

Text Books/Reference Books:

1. Arun Sharma, 2017 Teach Your Self Quantitative Aptitude, 1st Edition, McGraw Hills Education.
2. R S Aggarwal,2017, A Modern Approach to Logical Reasoning, S Chand & Company Pvt Ltd.
3. Yana Parker & Beth Brown, The Damn Good resume Guide
4. Ceri Roderick & Stephan Lucks, Interview Answers

Instructions for paper setting: Fifty MCQ will be set in total. Twenty five MCQ will be set from Part A and twenty five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Distribution of Continuous Evaluation:

Sessional- I	30%

Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Course Articulation Matrix :

CO Statement (BHM-MC-009)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BHM-MC-009.1	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1
BHM-MC-009.2	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1
BHM-MC-009.3	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-
BHM-MC-009.4	-	-	-	-	-	-	-	1	-	3	-	1	-	-	-
BHM-MC-009.5	-	-	-	-	-	-	-	1	-	3	-	-	-	-	-
BHM-MC-009.6	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1

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NAAC 'A' Grade University

BCS-DS-626: MANAGING THE CLOUD (CC)

Periods/week Credits	Max. Marks : 200
L :3 T: 0 3.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Introduction To Virtualization And Cloud Computing (BCS-DS-406)
Course Type: Program Electives

Course Outcomes: The students will be able to-

BCS-DS-626.1 Understand the cloud service workflow and the concept of metering and billing.
BCS-DS-626.2 learn the role of system administrator in cloud.
BCS-DS-626.3 Demonstrate how to maintain service catalogs.
BCS-DS-626.4 Summarize different cloud service provider business models.
BCS-DS-626.5 Describe general issues for the cloud growth planning.
BCS-DS-626.6 Manage cloud security and resiliency.

PART A

Unit-1: Service Management in Cloud

1.1 Concept Of Service Management
1.2 Characteristics Of Cloud Service Management
1.3 Cloud Service Management
1.4 Workflows In Cloud
1.5 Cloud Provisioning
1.6 Metering And Billing.

Unit-2: Cloud System Administration-I

2.1 System Administration
2.2 The Systems Administrator Role
2.3 Tasks Involved In System Maintenance
2.4 Pc Health Check
2.5 Patching And Updates,
2.6 Maintenance Outages.

Unit-3: Cloud System Administration-II

3.1 Sending Notifications
3.2 Maintaining The Service Catalogs
3.3 Troubleshooting
3.4 Configuration Management
    3.4.1 Configuration Management Principles
    3.4.2 Configuration Management And The Cloud
    3.4.3 Configuration Management – Introducing Chef.

PART B

Unit-4: Cloud Growth Planning-I

4.1 Forecasting The Requirements For Cloud Managed Resources, Establish Cloud Computing Infrastructure, Interoperability Between Cloud Providers,
4.2 The Cloud Service Provider Business
    4.2.1 Cloud Computing Is Important To Service Providers
    4.2.2 Importance Of Cloud Computing To The Services Ecosystem
    4.2.3 Cloud Computing Is Essential To Many Businesses
    4.2.4 Market Opportunity For Cloud Service Providers
4.3 Entering The Cloud Computing Marketplace
4.4 General Cloud Service Provider Business Models

4.5 Application Hosting On Cloud
    4.5.1 Customer Application Hosting
    4.5.2 Provider Application Hosting
    4.5.3 Third-party Models
    4.5.4 Pure Hosting
    4.5.5 Pure Aggregation
4.6 The Ibm Cloud Computing Reference Architecture (CCRA)
    4.6.1 Ibm Cloud Computing Solution
    4.6.2 The Ibm Cloud Computing Reference Architecture (ccra)
    4.6.3 Key Technical Capabilities
    4.6.4 Access Capabilities
4.7 Support Systems Capabilities
4.8 Shared System Capabilities
4.9 High Availability and Interoperability

Unit-5: Cloud Growth Planning-II

5.1 Implementing Cloud Computing Using Ibm Smartcloud For Service Providers Offerings.
    5.1.1 Workload definition
    5.1.2 Phased approach to deployment
    5.1.3 Architectural Decisions
    5.1.4 Cloud Service Provider Adoption Pattern Principles
    5.1.5 Component Model
    5.1.6 Operational Analytics And Financial Analytics And Reporting Reports,
5.2 Operational Views and Operational Environment
5.3 Operational View For Cloud Management
5.4 Operational View For Cloud Service Usage
5.5 Service Development And Onboarding
    5.5.1 Creating A Plan To Implement Your Cloud Computing Solution
    5.5.2 Influences On The Implementation Plan
    5.5.3 Usage Of Existing Systems
    5.5.4 Multiple Data Center Solutions
5.6 Ibm Cloud Service Provider Solutions
    5.6.1 Ibm Smartcloud Integrated Infrastructure For Service Providers,
5.7 Custom Service Provider Solutions
5.8 Storefront
5.9 Ibm Ecosystem Support
5.10 Cloud Service Provider Deployment Scenarios,
    5.10.1 Scenario One: Vertical Market Cloud Services Provider
    5.10.2 Scenario Two: Using Cloud To Drive Mobile Applications Business,
5.11 The Need For Service Catalog Design In Cloud Services Development.
    5.11.1 The Context :cloud Computing
    5.11.2 The Front End: Service Catalog
5.12 Developing An Optimum Service Catalog
5.13 Service Catalog Development Methodology And Framework
5.14 Current Environment (brownfield Vs. Greenfield)
5.15 Requirement Analysis Aspects, Business Requirements
    5.15.1 Service Capabilities
    5.15.2 Role-based Access
5.16 Governance And Compliance
    5.16.1 Purpose-built Clouds
    5.16.2 Geographical Constraints
5.17 Service Catalog Work Flows
    5.17.1 Business Drivers
    5.17.2 The Value Of Transformation
    5.17.3 Transformation At Work
    5.17.4 Closing Thoughts
5.18 Cloud Transformation
    5.18.1 Enabling The Transformation Towards Delivering The Right It To Your Business
    5.18.2 Challenges Of The It Function
    5.18.3 Enhanced Quality Of Experience For The Business Based On Services And Usage
5.19 Transforming It Into A Value-added Service Partner For The Business,

5.20 The Cloud Opportunity: A New Approach To Deliver The Right It
 5.20.1 The Cloud Business Opportunity
5.21 A Need To Align Your Organization To The Cloud Strategy.

Unit-6: Managing Security and Resiliency
6.1 Managing Security And Resiliency
6.2 Security Issues Associated With The Cloud
6.3 Cloud Security Controls,
 6.3.1 Dimensions Of Cloud Security
6.4 Security And Privacy
6.5 Compliance
6.6 Legal And Contractual Issues
6.7 Public Records
6.8 9 Worst Cloud Security Threats
 6.8.1 Data Breaches
 6.8.2 Data Loss
 6.8.3 Account Or Service Traffic Hijacking,
 6.8.4 Insecure Apis,
 6.8.5 Denial Of Service
 6.8.6 Malicious Insiders
 6.8.7 Abuse Of Cloud Services
 6.8.8 Insufficient Due Diligence
 6.8.9 Shared Technology
6.9 Top Security Risks
6.10 Key Security And Privacy Issues In Public Cloud
 6.10.1 Governance
 6.10.2 Compliance
 6.10.3 Trust
 6.10.4 Architecture

 6.10.5 Security Considerations
6.11 Security Best Practices
6.12 Security Considerations In Private Cloud
6.13 Best Security Practices
6.14 Security Considerations In Hybrid Cloud
6.15 General Security Countermeasures
6.16 Countermeasures For Challenges Inherited From Network Concept
6.17 Countermeasures For Cas Proposed Threats
6.18 Monitored Objects And The Probe Effect and Event Log Analysis
6.19 Patching
 6.19.1 Patch Management In Enterprise
 6.19.2 Patch Management In Cloud
 6.19.3 Major Areas Of Labor And Cost Inefficiencies
 6.19.4 Standardize Patch Management Services
 6.19.4.1 Solution Standardization For Patch Management
6.20 Managing The Operating System Resources
6.21 Policies And Mechanisms
6.22 Control The Cloud
6.23 Resource Management System
 6.23.1 Resource Types
 6.23.2 Enabling Technologies
 6.23.3 Resource Management Functions.

Text Books and Reference URLs :
1. Managing the cloud, IBM ICE Publication.

Software required/Weblinks:
www.vmware.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and

Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-626)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-626.1	1	2	3	1	3	-	1	1	2	-	2	2	3	-	1
BCS-DS-626.2	1	-	1	3	3	-	1	2	2	2	-	3	3	-	1
BCS-DS-626.3	1	-	1	2	3	-	1	2	2	2	-	2	3	-	1
BCS-DS-626.4	2	1	-	2	3	2	1	2	2	2	-	1	3	1	2
BCS-DS-626.5	2	2	1	2	3	2	-	2	3	2	1	1	2	-	2
BCS-DS-626.6	1	-	2	3	3	2	1	2	2	2	-	2	3	1	-

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NAAC 'A' Grade University

BCS-DS-677: MANAGING THE CLOUD LAB (CC)

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Managing The Cloud (BCS-DS-626)
Course Type: Program Electives

Course Outcomes: The students will be able **-**
BCS-DS-677.1. Understand the concept of virtualization.
BCS-DS-677.2. Tune system for better performance.
BCS-DS-677.3. Explore various features of public cloud.
BCS-DS-677.4. Demonstrate various networking tools for port scanning , tracing and capturing packets.
BCS-DS-677.5. Apply various tools to send encrypted data securely over the public network.

List of Practicals:
Program 1: Explore the various aspects of managing the cloud system.
Program 2: Install VMware Workstation. Create image and install guest operating systems.
Program 3: How to troubleshoot basic software issues?
Program 4: How to tune system for better performance?
Program 5: Using Amazon Cloud, understand basic idea of public cloud and explore basic idea of public cloud security.
Program 6: Using Microsoft Azzure cloud, Explore various features of public cloud.
Program 7: Understand the basic idea of port scanning using Superscan tool and Nmap tool.
Program 8: Using GPG4win tool, create security key for a message and apply encryption and decryption
Program 9: How to create secret key in windows using java.
Program 10: How to trace and capture packets using Wireshark tool.
Progam11: Hosting a static website on AWS- A mini project
Program12: Elearning platform using Cloud Comptuting- A mini project

Software required/Weblinks:

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination
COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-677)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-677.1	3	2	-	3	2	1	1	-	-	1	1	3	2	2	3
BCS-DS-677.2	3	3	-	2	2	1	2	-	-	1	1	2	2	-	3
BCS-DS-677.3	3	2	-	2	2	1	1	-	1	-	2	3	1	1	2
BCS-DS-677.4	3	3	2	1	3	-	-	1	1	-	-	3	2	-	3
BCS-DS-677.5	3	2	2	2	3	-	-	1	1	-	-	3	2	1	3

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BCS-DS-612: CLOUD APPLICATION DEVELOPMENT

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

PreRequisite: Basics of Cloud Computing
Course Type: Program Core
Course Objective:
1.To understand design and development process involved in creating a cloud based application.
2. Developing and Deploying an Application in the real cloud .
Course Outcomes: The students will be able to-
BCS-DS-612.1 Understand the cloud computing fundamentals
BCS-DS-612.2 Understand and Deploy the application of cloud computing on real cloud.
BCS-DS-612.3 Analyze the management of cloud services
BCS-DS-612.4 Use application based technologies for developing application using cloud.
BCS-DS-612.5 Design and Deploy real cloud services.

Unit-1: Cloud Computing Fundamentals
1.1. Cloud types; IaaS, PaaS, SaaS,
1.2. Next generation Cloud Applications - Cloud computing Architecture,
1.3. Role of virtualization in enabling the cloud , Application availability, performance, security and disaster recovery,
1.4. Cloud containers: Industrial and Consumer

Unit-2: Cloud Applications
2.1 Web Service Architecture ,Web Service APIs, Web service Authentication ,Web service authentication methods,
2.2 Technologies and the processes required when deploying web services,
2.3 Deploying a web service from inside and outside a cloud architecture, Advantages and disadvantages

Unit-3: Creating and managing Cloud application
3.1 Class and Method design to make best use of the Cloud infrastructure,
3.2 Web Browsers and the Presentation Layer, Understanding Web browsers attributes and differences,
3.3 Building blocks of the presentation layer: HTML, HTML5, CSS, Silverlight, and Flash, Application Lifecycle Management Tools,
3.4 Integration of Application Lifecycle Management Tools with Clouds, Rational Application Developer

Unit-4: Implementing Reliable Messaging and Communications with the Cloud
4.1 Order processing components in the on-premises application, Receiving Messages from a Service Bus Queue and Processing Them Asynchronously,
4.2 Flow of control when receiving messages through a Service Bus Receiver Handler object
4.3 Minimizing Network Latency and Maximizing Connectivity of Application,
4.4 Optimizing the Response Time of Application

Unit-5: Monitoring and Managing Cloud Application
5.1 Software Installation and Management , Red Hat Package Management
5.2 Software Management on SUSE ,Cloud Software Bundles
5.3 Asset Management, Maintaining Compatibility with Future Versions of Software

Text Books / Reference Books:

1. Guo Ning Liu, Qiang Guo Tong, Harm Sluiman, Alex Amies, "Developing and Hosting Applications on the Cloud", IBM Press (2012)
2. Eugenio Pace, Dominic Betts, Scott Densmore, Ryan Dunn, Masashi Narumoto, Matias Woloski, Developing Applications for the Cloud on the Microsoft Windows Azure Platform [ISBN: 9780735656062]
3. Chris Hay, Brian Prince, Azure in Action [ISBN: 978-1935182481],2018

3.Dan Sanderson, "Programming Google App Engine" O'Reilly Media; 1 edition [ISBN: 978-0596522728],2009.

4. "Building Hybrid Applications in the Cloud on Windows Azure" Version:3.0, Microsoft, 2013.

Software required/Weblinks:

https://onlinecourses.nptel.ac.in/noc21_cs62/preview

https://www.coursera.org/specializations/ibm-cloud-application-development-foundations

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials

Sessional tests

Surprise questions during lectures/Class Performance

End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement(BCS -DS-612)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-612.1	2	-	-	-	-	-	-	-	-	-	-	2	2	-	-
BCS-DS-612.2	1	2	-	3	3	-	-	-	2	1	2	3	-	3	3
BCS-DS-612.3	3	-		-	-	-	-	-	-	-	-	2	2	-	-
BCS-DS-612.4	3	2	-	3	3				3	-	-	-	-	3	-
BCS-DS-612.5	-	-	-	3	3		-	-	1	-	-	3	3	3	3

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BCS-DS-662 : Cloud Application Development Lab

Periods/week Credits	Max. Marks	: 100
P :2 1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs	End Sem Examination	: 50

CoRequisite: Cloud Application Development
Course Type: Program Core
Course Outcomes: The students will be able to-
BCS-DS-662.1 : Understand the implementation procedures for virtual machines of different configuration.
BCS-DS-662.2 :To learn the design and development process involved in creating a cloud-based application.
BCS-DS-662.3 :To understand tool kits for cloud environment.
BCS-DS-662.4 :To develop web applications in cloud framework.
BCS-DS-662.5 :Use public cloud like IBM Bluemix, Amazon AWS, Google cloud platform or Microsoft Azure for developing an application.

List of Practicals:

1. Write a program to install Turbo C in guest OS and execute C program.
2. Write a program with ping command to test the communication between the guest OS and Host OS.
3. Write a program to Install Virtual box/VMware Workstation with different versions
4. of linux or windows OS on top of windows.
5. Write a program to install Hadoop single node setup.
6. Write a program to develop a hadoop application named as “Word Count” which
7. counts the number of each word in a given data set.
8. Write a program to simulate a cloud scenario using Cloud Sim and run a scheduling
9. algorithm that is not present in Cloud Sim.
10. Write a program to use GAE launcher to launch the web applications.
11. Write a program to establish an AWS account. Use the AWS Management Console
12. to launch an EC2 instance and connect to it.
13. Write a program to develop a Hello World application using Google App Engine
14. Write a program to establish an AWS account. Use the AWS Management Console
15. to launch an EC2 instance and connect to it.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	20%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam
COURSE ARTICULATION MATRIX :

CO		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO	PSO2	PSO3

Statement (BCS-DS-662)												1		
BCS-DS-662.1	-	1	-	-	-	-	-	-	2	-	-	2	2	-
BCS-DS-662.2	-	2	2	1	-	-	-	1	2	2	-	-	1	2
BCS-DS-662.3	-	3	1	1	-	-	-	1	-	-	-	2	3	3
BCS-DS-662.4	1	3	1	-	-	-	-	-	-	-	2	2	2	2
BCS-DS-662.5	3	3	2	3	-	-	1	2	3	1	2	3	-	3

BCS-DS-310: DISTRIBUTED COMPUTING

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: NIL
Course Type: Program Core

Course Outcomes: Students will be able to-

BCS-DS-310.1	To know about Shared Memory Techniques
BCS-DS-310.2	To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security,
BCS-DS-310.3	To provide hardware and software issues in modern distributed systems.
BCS-DS-310.4	Have sufficient knowledge about file access.
BCS-DS-310.5	Have knowledge of Synchronization and Deadlock.
BCS-DS-310.6	To get the knowledge of distributed file systems.

PART-A

Unit-1: Fundamentals of Distributed Computing System

1.1 Evolution of Distributed Computing Systems,
1.2 System models,
1.3 issues in design of Distributed Systems,
1.4 Distributed computing environment,
1.5 web based distributed model,
1.6 Computer networks related to distributed systems and
1.7 web based protocols.

Unit-2: Message Passing
2.1 Inter process Communication,
2.2 Desirable Features of Good Message-Passing Systems,
2.3 Issues in IPC by Message,
2.4 Synchronization,
2.5 Buffering,
2.6 Multidatagram Messages,
2.7 Encoding and Decoding of Message Data,
2.8 Process Addressing,
2.9 Failure Handling and Group Communication.

Unit-3: **Remote Procedure Calls**
3.1 The RPC Model,
3.2 Transparency of RPC,
3.3 Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results,
3.4 Server Management,
3.5 Communication Protocols for RPCs,
3.6 Complicated RPCs,
3.7 Client-Server Binding,
3.8 Exception Handling, Security,
3.9 Some Special Types of RPCs, Lightweight RPC, Optimization for Better Performance.

PART-B

Unit-4: Distributed Shared Memory
4.1 Design and Implementation issues of DSM,
4.2 Granularity,
4.3 Structure of Shared memory Space,
4.4 Consistency Models,
4.5 replacement Strategy, Thrashing,
4.6 Other Approaches to DSM,
4.7 Advantages of DSM.

Unit-5: Synchronization and Resource and Process Management
5.1 Clock Synchronization,
5.2 Event Ordering,
5.3 Mutual Exclusion,
5.4 Election Algorithms.
5.5 Desirable Features of a good global scheduling algorithm,
5.6 Task assignment approach,
5.7 Load Balancing approach,
5.8 Load Sharing Approach,
5.9 Process Migration, Threads, Processor allocation, Real time distributed Systems.

Unit-6: Distributed File Systems
6.1 Desirable Features of a good Distributed File Systems,
6.2 File Models,
6.3 File Accessing Models,
6.4 File-shearing Semantics,
6.5 File caching Schemes, File Replication, Fault Tolerance,
6.6 Design Principles,
6.7 Sun's network file system, Andrews file system, comparison of NFS and AFS.

Text Book:
1. Distributed OS by Pradeep K. Sinha (PHI)
2. Tanenbaum S.: Distributed Operating Systems, Pearson Education
3. Tanenbaum S. Maarten V.S.: Distributed Systems Principles and Paradigms, (Pearson Education)
4. George Coulouris, Jean Dollimore. Tim Kindberg: Distributed Systems concepts and design.

Software required/Weblinks:
https://www.ibm.com/docs/en/txseries/8.2?topic=overview-what-is-distributed-computing
https://hazelcast.com/glossary/distributed-computing/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-527)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-310.1	3	-	-	-	-	3	-	2	-	-	-	-	-	-	3

BCS-DS-310.2	3	-	-	-	-	3	-	2	-	-	-	-	-	-	3
BCS-DS-310.3	3	-	-		3	3	-	2	-	3	-			-	3
BCS-DS-310.4	2	-	-		-	3	-	2	-	3	-	-		-	3
BCS-DS-310.5	2	-	-		-	3	-	2	-	-	-	-		-	3
BCS-DS-310.6	2	-	-		-	3	-	2	-	-	-	-		-	3

BCS-DS-625: Data Warehouse and Data Mining

Periods/week	Credits	Max. Marks : 200
L: 3 T: 0	3.0	Continuous Evaluation : 100
Duration of Examination: 3 Hrs		End Sem Examination : 100

Pre-Requisite: Database Management Systems(BCS-DS-404)
Course Type: Program Electives

Course Outcomes: Students will be able to-

BCS-DS-531.7. Rephrase the concept of Data Warehouse, multidimensional data model, Data cubes and the difference between DBMS and Data Warehouse.
BCS-DS-531.8. Analyze the schemas for Multidimensional Database like stars, snowflakes and fact constellation.
BCS-DS-531.9. Design three-tier Data Warehouse architecture and the types of OLAP Servers.
BCS-DS-531.10. Examine data cubes, data warehouse backend tools, utilities and data preprocessing. Also various Data Mining techniques like association rule, clustering, classification will be introduced.
BCS-DS-531.11. Judge pattern presentation & visualization specification, data mining languages and architectures of Data Mining systems.
BCS-DS-531.12. Validate spatial databases, multimedia databases along with time series and sequence data.

PART- A

Unit-1: Introduction to Data Warehousing

1.1 Concept of Data Warehouse,
1.2 DBMS verses data warehouse,
1.3 Data Marts.
1.4 Metadata,
1.5 Multidimensional data model,
1.6 Data cubes,
1.7 Multidimensional database,
1.8 Schemas for Multidimensional Database: stars, snowflakes and fact constellations.
1.9 Data warehouse Measures, their categorization and computation
1.10 Multi-dimensional database hierarchies
1.11 Operations in OLAP
1.12 Advantages of OLAP over OLTP

Unit–2: Data Warehouse Architecture

2.1 Three-Tier Data Warehouse architecture
2.2 Types of OLAP Servers, Initializing class objects with constructors,
2.3 ROLAP versus MOLAP versus HOLAP
2.4 Distributed and Virtual Data Warehouses,
2.5 Data Warehouse Manager.

Unit-3: Data Warehouse Implementation

3.1. Computation of data cubes,
3.2. Indexing OLAP data
3.3. Modeling OLAP data,
3.4. OLAP queries manager,
3.5. Processing of OLAP queries,
3.6. Data warehouse backend tools and utilities
3.7. Discovery-driven exploration of data cube
3.8. Complex aggregation at multiple granularities
3.9. Data preprocessing: Data cleaning, Data integration and transformation, Tuning and Testing of Data Warehouse.

PART- B

Unit-4: Introduction to Data Mining

4.1 Basic Concepts of Data Mining.

4.2 Data Mining primitives: Task-relevant data, mining objective, measures and identification of patterns,
4.3 KDD versus data mining,
4.4 Data mining tools and applications,
4.5 Data Mining Query Languages: Data specification, specifying kind of knowledge.
4.6 Hierarchy specification,
4.7 Pattern presentation &visualization specification,
4.8 Data mining languages and standardization of data mining,
4.9 Architectures of Data Mining Systems.

Unit-5: Data Mining Techniques
5.1 Association rules: Association rules from transaction database & relational database, correlation analysis,
5.2 Classification and predication using decision tree induction,
5.3 Clustering techniques,
5.4 Partition method.
5.5 Hierarchical method.

Unit-6: Overview of Advanced Features of Data Mining
6.1. Mining complex data objects,
6.2. Spatial databases,
6.3. Multimedia databases,
6.4. Time series and Sequence data.
6.5. Mining Text Databases and mining Word Wide Web.

Text Books / Reference Books:

1. Arun Pujar, 2010, Data Mining Techniques, 2nd Edition, Orient Black Swan/ Universities Press.
2. Alex Berson, 2004, Data Warehousing, Data Mining and OLTP, 1st Edition, MGH.
3. W.H. Inman, 2005, Building the Data Warehouse, 4th Edition, John Wiley & Sons.
4. W.H Ionhman, C.Klelly, 1993, Developing the Data Warehouses, John Wiley & Sons.
5. Sourav S Bhowmick , Sanjay K Madria , Wee K Ng , Hardcover,2003, Web Data Management, Springer.
6. Pieter Adriaans & Dolf Zantinge, 1997, Data Mining, Pearson,

Software required/Web links:
RapidMiner, WEKA, KNIME.
www.w3schools.com
www.tutorialspoint.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

(BCS-DS-625)														
BCS-DS-625.1	3	-	2	-	-	-	1	-	-	-	-	1	-	-	-
BCS-DS-625.2	-	2	3	2	-	1	-	1	-	-	-	-	-	-	-
BCS-DS-625.3	3	-	2	-	-	-	-	-	-	-	-	3	-	-	-
BCS-DS-625.4	-	-	-	3	3	-	-	-	-	-	-	-	2	-	-
BCS-DS-625.5	-	2	3	2	2	-	-	-	-	-	-	-	3	-	-
BCS-DS-625.6	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-

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BCS-DS-601: BACKUP & DISASTER RECOVERY (CC)

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Prerequisite: Knowledge about different storage devices and the equipments used in networking.
Course Type: Program Core

Course Outcomes: Student will be able to-

BCS-DS-601.1 Understand basic information storage devices.
BCS-DS-601.2 Explain Backup and its different types to handle data loss.
BCS-DS-601.3 Describe the concept of High availability.
BCS-DS-601.4 Summarize the working and need of network layers of the OSI model and TCP/IP.
BCS-DS-601.5 Identify the different types of disaster recovery methods.
BCS-DS-601.6 Apply the disaster recovery techniques.

PART- A

Unit 1 Backup Devices

1.1 Disk Storage, Characteristics Of A Disk Drive,
1.2 Types Of Disk Drives, Access Centric Drives,
1.3 Capacity Centric Drives, Disk Systems,
1.4 Tape, Specifications Of Lto-6, Worm, Automated Tape Library.

Unit 2 Introduction to Backup

2.1 Backup, Recovery Objectives
2.2 Rpo: Recovery Point Objective, Rto: Recovery Time Objective,
2.3 Types Of Backup, Full Backup, Incremental Backup,
2.4 Differential Backup, Progressive Incremental Backup,
2.5 Architectures Of Backup, Network Based Backup,
2.6 Disk To Disk To Tape (d2d2t) Backup, Network Free (san) Backup,
2.7 Server Free Or Server Less Backup, Network Data Management Protocol (ndmp) Backup,
2.8 Virtual Tape Library, Archive.

Unit 3 High Availability-I

3.1 Overview Of High Availability, High Availability,
3.2 Reliability, Serviceability & Availability,
3.3 Need Of Availability, Terminologies,
3.4 Components That Affect Availability & The Need For High Availability,
3.5 Availability Levels And High Availability, How High Availability Can Be Achieved,
3.6 Single System, Fault Tolerant, Redundant Components,
3.7 Monitoring, Alerting And Notification, Hot Swap And Hot Plug,
3.8 High Availability Clustering, High Availability Components.

PART- B

Unit 4 High Availability-II

4.1 Types Of Ha Solutions, Ha Clustering Advantages,
4.2 High Availability Criteria, Network Layer High Availability,
4.3 Hardware Combinations And Ha Possibilities,
4.4 Application & Operating System Layer, Hardware Layer: Storage,
4.5 High Availability For Virtual Environments, Components Of A Virtual Machine, High Availability On Virtual Machines.

Unit 5 Disaster Recovery-I

5.1 Introduction, Disaster Recovery, Types Of Disasters,
5.2 Business Continuity (bc) And Disaster Recovery (DR),
5.3 Importance Of Disaster Recovery, DR Terminologies,
5.4 Quantitative Terminologies, Availability Terminologies,
5.5 Networking / Communication Terminologies, Location Designations.

Unit 6 Disaster Recovery-II

6.1 Disaster Recovery Planning, Phases Of Planning,
6.2 Getting Acceptance, Form A DR Team,

6.3 Agree On The Recovery Service Levels, Plan A DR Strategy,
6.4 Implement The Strategy, Plan The Test And Test The Plan,
6.5 DR Technology Tree, High Availability,
6.6 Virtualization, Replication, Local Replication, Remote Replication,
6.7 Replication Tools, Deployment Topologies,
6.8 Two Site Replication, Multi-site Replication, DR Drill And The DR

Text Books:

1. Backup & Disaster Recovery, IBM ICE Publication.
2. High Availability and Disaster Recovery: Concepts, Design, Implementation, Springer Publication.
3. Pro Data Backup and Recovery-Expert's Voice in Data Management, Apress.

Software required/Weblinks:

https://en.wikipedia.org/wiki/Disaster_recovery_plan
https://www.eatelbusiness.com/blog/-/blogs/five-steps-to-a-data-backup-and-disaster-recovery-plan
https://www.ibm.com/support/knowledgecenter/en/ssw_ibm_i_73/rzarm/rzarmdisastr.htm
https://www.expedient.com/blog/what-are-the-differences-between-backups-and-disaster-recovery/

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Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-601)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-601.1	2	2	1	1	2	-	2	3	1	2	2	3	2	1	1
BCS-DS-601.2	2	1	2	3	-	1	2	-	1	2	2	2	1	2	1
BCS-DS-601.3	3	1	2	-	2	-	2	-	2	-	-	2	2	-	2
BCS-DS-601.4	2	3	2	2	1	-	1	-	2	-	-	2	1	2	1
BCS-DS-601.5	2	3	3	2	3	2	1	1	2	1	2	3	-	3	2
BCS-DS-601.6	2	2	-	2	2	-	-	2	-	-	-	3	2	-	3

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BCS-DS-602: Machine Learning

Periods/week Credits	Max. Marks : 200
L: 3 T: 1 4.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Nil
Course Type: Program Elective

Course Outcomes: Students will be able to-
BCS-DS-602.1. Outline the techniques, mathematical concepts, and algorithms used in machine learning.
BCS-DS-602.2. Describe the basic concepts of statistics, artificial intelligence, information theory and probability theory relevant to machine learning.
BCS-DS-602.3. Understand Supervised learning techniques for regression and classification in machine learning
BCS-DS-602.4. Apply the appropriate machine learning technique using unsupervised techniques for pattern recognition, optimization and decision problems
BCS-DS-602.5. Design the algorithms and techniques to solve problems using Artificial Neural Networks.
BCS-DS-602.6. Analyze the complexities of various problems in different domains.

PART- A

Unit-1: **Introduction Basic Concepts**
1.1 Probability Theory
1.2 Probability densities
1.3 Types of Variables: Quantitative & Qualitative
1.4 Measures of Central Tendency
1.5 Measures of Spread: Range, Variance, Standard deviation
1.6 Population parameters and Sample Statistics
1.7 Bayesian probabilities and Bayes Theorem
1.8 Gaussian distribution

Unit-2: Machine Learning
2.1 Introduction to Machine Learning Concepts
2.2 Types of Machine Learning Algorithms
2.3 Dimensionality Reduction Techniques: (PCA -Principal components analysis)
2.4 Feature Extraction
2.5 Feature Selection

Unit-3: Supervised Learning
3.1 Introduction to supervised learning setup
3.2 Regression and Classification
3.3 Linear Regression
3.4 Logistic Regression
3.5 Naive Bayes Classifier Algorithm
3.6 Support vector machines
3.7 Ensemble methods: Bagging, Boosting
3.8 Evaluating and debugging learning algorithms

PART- B

Unit-4: Unsupervised Learning
4.1 Introduction to Unsupervised learning
4.2 Clustering techniques
4.3 Common distance measures
4.4K-means algorithm
4.5Hierarchical agglomeration

4.6 Cross Validation and Resampling Methods
4.7 Assessing the performance of an algorithm

Unit 5: **Artificial Neural Network**
5.1 Introduction to Neural Networks
5.2 Neural Network representation
5.3 Gradient Descent
5.4 Perceptron, Multilayer perceptron
5.5 Backpropagation algorithm
5.6 Feed-forward Network Networks
5.7 Network Training – Parameter optimization

Unit 6:**Deep Learning**
6.1 Inductive Learning
6.2 Graph-Based Learning
6.3 SVM (Support Vector Machine) and Kernel Methods
6.4 Generative Methods
6.5 Human Cognitive Learning

Text Books / Reference Books:

1. S. Haykin. 2008, Neural networks and learning machines. Pearson.
2. Mitchell, Tom. 1997, Machine Learning. New York, NY: McGraw-Hill, ISBN: 9780070428072
3. Rbchard o Duda, Peter E. Hart and David G. Stork, 2001 pattern Classification, John Wiley & Sons Inc.
4. Chris Bishop, 2007, Pattern Recognition and Machine Learning, Springer-Verlag New York, ISBN: 978-0-387-31073-2

Software required/Weblinks:
Python, R language
www.tutorialpoint.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-602)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-602.1	2	2	-	-	-	-	-	-	-	-	-	-	-	1	-
BCS-DS-602.2	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-
BCS-DS-602.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BCS-DS-602.4	3	3	2	-	1	-	-	-	-	-	1	1	1	-	1
BCS-DS-602.5	2	-	2	1	1	-	-	-	-	1	-	-	1	1	1

BCS-DS-602.6	2	2	-	2	-	1	-	-	-	-	-	1	1	-	1

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BCS-DS-652: Machine Learning Lab

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Machine Learning (BCS-DS-602)
Course Type: Program Core

Course Outcomes: Students will be able to-
BCS-DS-652.1. Understand the implementation procedures for the machine learning algorithms.
BCS-DS-652.2. Design Java/Python programs for various Learning algorithms.
BCS-DS-652.3. Apply appropriate data sets to the Machine Learning algorithms.
BCS-DS-652.4. Identify Machine Learning algorithms to solve real world problems.
BCS-DS-652.5. Formulate clustering algorithm for solving the problem.
BCS-DS-652.6. Implement the pre-processing operations on given dataset.

List of Practicals:
1. Write a program to import the datasets of Real-time/Offline applications.
2. Perform various operations on the dataset using Numpy module for numerical computation.
3. Perform dataset handling operations using Pandas.
4. Implement different preprocessing operations on the given dataset.
5. Write a program to the demonstrate the working of Linear Regression. Use an appropriate dataset and evaluate the results.
6. Write a program to the demonstrate the working of Logistic Regression. Use an appropriate dataset and evaluate the results.
7. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
8. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Write a program to Implement K-means clustering. Use appropriate dataset and evaluate the algorithm.
11. Design a Stock Price Predictor.
12. Design Recommendation System for any domain.

Software Required/Weblinks:
https://nptel.ac.in/courses/106016139/
htttps://www.courseera.org/learn/big-data-machine-learning
https://cognitive.ai/courses/machine-learning-with-python

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)

End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-652)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-652.1	1	-	1	-	-	-	-	-	-	2	-	-	2	2	-
BCS-DS-652.2	3	-	2	2	1	-	-	-	1	2	2	-	-	1	2
BCS-DS-652.3	2	-	3	1	1	-	-	-	1	-	-	-	2	3	3
BCS-DS-652.4	3	1	3	1	-	-	-	-	-	-	-	2	2	2	2
BCS-DS-652.5	2	2	3	1	-	-	-	-	-	-	2	2	-	3	-
BCS-DS-652.6	3	3	3	2	3	-	-	1	2	3	1	2	3	-	3

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BCS-DS-603: Internet of Things (IOT)

Periods/week Credits	Max. Marks : 200
L: 3 T: 1 4.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Elective

Course Outcomes: Student will be able to-
BCS-DS-603.1. Describe concepts and technologies of IoT communication.
BCS-DS-603.2. Map out the processes for IoT solutions and data management in IoT.
BCS-DS-603.3. Identify different infrastructure components including sensors, embedded hardware, gateways and network systems for IoT applications.
BCS-DS-603.4. Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack.
BCS-DS-603.5. Illustrate security requirements and privacy risks in IoT communication.
BCS-DS-603.6. Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.

PART- A

Unit-1: Introduction to IoT
1.1 Introduction to IoT Communications
1.2 IoT categories: Industrial and Consumer
1.3 IoT components and implementation: Functional blocks
1.4 Layered architecture of IoT
1.5 Machine to Machine Communication, IoT vs M2M
1.6 IoT Enabling Technologies

Unit-2: IoT Communication
2.1 IoT Network Configurations: Node, PAN, LAN, WAN, Gateway, Proxy
2.2 IoT Communication: IoT Protocol Stack
2.3 IoT Communication Models
2.4 Connectivity technologies: IEEE802.15.4, ZigBee, 6LOWPAN, Bluetooth, Z-wave, RFID
2.5 MQTT, CoAP, XMPP, AMQP

Unit-3: IoT Systems and Networks
3.1 Study of RF Wireless Sensors
3.2 Wireless Sensor Networks
3.3 Components of a sensor node
3.4 Challenges in Wireless sensor networks, Node Cooperation
3.5 WSN Coverage
3.6 Network Devices

PART-B

Unit-4: Elements of IoT Application Development
4.1 Component based IoT Reference Model
4.2 Hardware Components- Computing (Arduino, Raspberry Pi), Sensing, Actuation.
4.3 Software Components- Programming API's (using Python/Arduino) for Communication
4.4 IoT Platforms: Capabilities and Examples
4.5 Device Data Storage on Cloud: Sensor Cloud Architecture and Applications
4.6 Fog Computing: Requirement and Architecture

Unit-5: IoT Security Frameworks
5.1 Challenges in IoT Implementation

5.2 IoT Security Threats
5.3 Security Requirements of IoT Communications
5.4 Principles of Secure IoT Communication
5.5 IoT Security Framework

Unit-6: IoT Applications/ Case Studies
6.1 Home Automation
6.2 Asset Management
6.3 Tagging and Tracking for Healthcare applications
6.4 Connected Vehicles
6.5 Smart Irrigation
6.6 Smart Cities

Text Books / Reference Books:

1.Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, "A Hands on Approach", University Press
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
5. Adrian McEwen, "Designing the Internet of Things", Wiley
6. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill
7. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media

Software required/Weblinks:
https://onlinecourses.nptel.ac.in/noc17_cs22
www.analyticsvidya.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-603)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-603.1	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
BCS-DS-603.2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
BCS-DS-603.3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
BCS-DS-603.4	-	-	2	3	2	-	-	-	-	-	-	-	-	-	-
BCS-DS-603.5	-	-	-	-	-	2	3	1	-	-	-	-	-	-	-
BCS-DS-603.6	-	-	-	2	2	3	-	-	-	1	-	2	1	-	-

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BCS-DS-653: Internet Of Things (IOT) lab

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Internet Of Things (IOT) (BCS-DS-603)
Course Type: Program Core

Course Outcomes: Students will be able to-
BCS-DS-653.1 Identify different infrastructure components including sensors, embedded hardware, gateways and network systems for specified IoT application.
BCS-DS-653.2 Set up an embedded/microcomputer system and enable to write IoT application on it.
BCS-DS-653.3 Integrate microcontroller/microcomputer system with sensors to acquire data in real time.
BCS-DS-653.4 Establish a secure and consistent communication from microcontroller/microcomputer system to the cloud.
BCS-DS-653.5 Design an application to create communication with multiple sensors to store data locally and make it available on the Internet for subsequent comparison with cloud data.
BCS-DS-653.6 Apply the knowledge and skills acquired during the course to design IoT based solutions for real world problems.

List of Experiments
1. Familiarization with Arduino board and perform necessary software installation.
2. To interface LED with Arduino and write a program to blink LED at defined delay.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino and write a program to turn ON LED when push button is pressed or at sensor detection.
4. Working with A/D conversion and sensor integration.
5. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when 'A'/'B' is received from smartphone using Bluetooth.
6. Creating own Android App using MIT App Inventor, controlling Arduino connected devices and sending data to ThingSpeak cloud.
7. Introduction to Raspberry-Pi: Setup and Procedure.
8. Controlling GPIO Pins of Raspberry-Pi to blink interfaced LED.
9. Sending sensor data to ThingSpeak cloud via R-Pi.
10. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to upload temperature and humidity readings to ThingSpeak cloud.
11. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
12. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
13. Study of other equivalent SBC boards for IoT applications.
14. Design a Car Parking Management System.
15. Design a Home Automation System.
16. Create SMS Door Alarm with LinkIt ONE.

Reference Books:

1. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
2. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
3. Adrian McEwen, "Designing the Internet of Things", Wiley
4. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media

Software Required/Weblinks:
https://www.arduino.cc/
https://www.raspberrypi.org/

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-653)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-653.1	1	3	-	-	-	-	-	-	-	-	-	1	-	-	1
BCS-DS-653.2	-	-	3	1	-	2	-	-	-	-	-	1	-	-	-
BCS-DS-653.3	-	-	2	2	-	-	-	-	-	-	-	1	-	-	-
BCS-DS-653.4	-	-	-	-	3	2	2	-	-	-	-	1	-	-	-
BCS-DS-653.5	-	-	-	2	3	3	2	-	-	-	-	1	1	-	-
BCS-DS-653.6	-	-	-	-	2	2	3	-	1	-	2	1	-	2	-

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BCS-DS-621: Software Testing And Quality Assurance

Periods/week Credits	Max. Marks	: 200
L: 3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Student will be able to-
BCS-DS-621.1. List various software testing problems.
BCS-DS-621.2. Apply various test strategies, plans, design test cases, prioritize.
BCS-DS-621.3. Estimate incidents and risks within a project.
BCS-DS-621.4. Test efficient delivery of software solutions and implement improvements in the SDP.
BCS-DS-621.5. Judge alternative standards, models and techniques aimed at achieving quality assurance in a variety of software development environments.
BCS-DS-621.6. Plan research, consolidate and present large amounts of information related to appropriate quality assurance techniques.

PART- A

Unit-1: Introduction to Software Testing
1.1. Introduction, Basics of Software Testing, Testing Principles and Goals,
1.2. Testing Life Cycle, Phases of Testing, Limitations of Testing,
1.3. Concepts of failure, fault, bug, defect, error, incident, Defect Life Cycle, Defect Report,
1.4. Test Plan, Importance of Testing in software production cycle, testing principles,
1.5. Verification, validation, unit testing, integration testing system, system testing, regression
1.6. testing, alpha, beta and acceptance testing , functional testing, performance testing,
1.7. recovery testing,

Unit-2: Black Box Approach
2.1. Introduction, Need of black box testing, Black box testing Concept,
2.2. Requirement Analysis, Test case design criteria, Testing Methods, requirement based testing,
2.3. Positive & negative testing, Boundary value analysis,
2.4. Equivalence Partitioning class, state based or graph based, cause effect graph based,
2.5. Error guessing, documentation testing & domain testing, design of test cases, Case studies of
2.6. Black-Box testing,

Unit-3: White Box Approach
3.1. Introduction, Need of white box testing, Testing types, Test adequacy criteria,
3.2. Static testing by humans, Structure, logic coverage criteria, Basis path testing,
3.3. Graph metrics, Loop Testing, Data flow testing, Mutation Testing,
3.4. Design of test cases, Testing of Object oriented systems,
3.5. Challenges in White box testing, Case-study of White-Box testing,

PART-B

Unit-4: Test Management and Test Metrics
4.1. Test organization, Structure of testing, Measurement tools,
4.2. Testing metrics: Type of metrics, Project, Progress, Productivity, Metric plan, Goal Question metric model, Measurement in small and large systems,
4.3. Other Software Testing: GUI testing, Validation testing, Regression testing,
4.4. Scenario testing, Specification based testing, Ad hoc testing, Sanity testing,
4.5. Smoke testing, Random Testing, Advances in Software Testing Methods, object oriented Testing,

Unit-5: Quality Concepts & Software Quality Assurance
5.1. Quality concepts: Quality, Quality control, Quality Assurance, cost of quality,
5.2. Methods of Quality Management, Quality factors, Quality metrics,

5.3. Software quality assurance, SQA activities, software reviews, inspections, audits, Software Reliability,
5.4. Quality Attributes: Correctness, Reliability, Usability, Integrity, Portability, Maintainability, Interoperability,
5.5. Software Quality assurance framework, software quality assurance plan,

Unit-6: Quality Standards

6.1. Quality standards, ISO 9000and others ISO standards,
6.2. CMM, CMMI, PCCM,
6.3. 3-Sigma, 6-Sigma,
6.4. TQM, SQA Model.

Text Books / Reference Books:

1. Cam kaner, James Bach, Bret Pettichord, 1999, Lesson learned in software testing, 2nd Edition, John Wiley & Sons.
2. Ron Patton, 2006, Software Testing, 2nd Edition, Sams.
3. Boris Beizer, 1990, Software testing techniques, 2nd Edition, Van Nostrand Reinhold Company.
4. Marc Roper, 1994, Software Testing, 5th Edition, McGraw-Hill.
5. G. Gordon Schulmeyer , 2007, Handbook of Software Quality Assurance, 3rd Edition, Artech House.
6. Kshirasagar naik, Priyadarshi Tripathy, 2008, Software testing and Quality Assurance, 1st Edition, Wiley-Blackwell.

Software Required/Weblinks:

https://www.tutorialspoint.com/software_testing_dictionary/quality_assurance.htm
http://actoolkit.unprme.org/wp-content/resourcepdf/software_testing.pdf
www.nptel.com
http://www.qatutorial.com/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-621)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-621.1	2	-	-	2	-	-	1	-	-	-	-	3	3	-	-
BCS-DS-621.2	2	1	-	1	2	-	-	-	-	2	-	-	-	2	-
BCS-DS-621.3	1	2	1	-	-	-	-	1	-	-	1	1	2	1	-
BCS-DS-621.4	3	-	-	3	3	-	1	-	-	-	2	1	1	3	-
BCS-DS-621.5	-	1	1	-	1	-	-	-	-	-	2	1	-	2	-
BCS-DS-621.6	2	1	3	1	2	-	-	-	-	1	-	2	2	1	-

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BCS-DS-622A: Advance Data Base Management Systems

Periods/week Credits	Max. Marks	: 200
L: 3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Database Management Systems (BCS-DS-404)
Course Type: Program Electives

Course Outcomes: Students will be able to-

BCS-DS-622A.1.	Demonstrate the basic elements of a relational database management and no-sql databases.
BCS-DS-622A.2.	Identify the data models for relevant problems.
BCS-DS-622A.3.	Design entity relationship and convert entity relationship diagrams into RDBMS and formulate SQL queries on the respect data into RDBMS and formulate SQL queries on the data.
BCS-DS-622A.4.	Demonstrate their understanding of key notions of query evaluation and optimization techniques for various databases.
BCS-DS-622A.5.	Extend normalization for the development of application software�given with relational database management and no-sql databases.

PART-A

Unit-1: Database Design and Implementation: Relational Database Design

1.1 Features of good database design
1.2 Enhanced ER tools
1.3 Subclasses, Super class, and Inheritance
1.4 Specialization and Generalization
1.5 Constraints and Characteristics of Specialization and Generalization
1.6 Converting EER diagram to tables
1.7 Functional dependency theory and normalization
1.8 Multi value dependency and 4NF
1.9 Join Dependency and 5NF
1.10 Inclusion Dependencies and Template Dependency
1.11 PJNF/DKNF
1.12 Modeling temporal data

Unit-2: Advanced SQL

2.1 Assertion and views
2.2 Cursors, triggers and stored procedures
2.3 Embedded SQL, dynamic SQL, SQLJ,
2.4 Advanced Features of SQL
2.5 Examples of above in Oracle

Unit-3: DBMS Advanced Features and Distributed Database: Query Processing and Evaluation

3.1 Measures of Query Cost
3.2 Selection Operation,
3.3 Sorting
3.4 Join Operation&other Operations
3.5 Evaluation of Expression
3.6 Transformation of Relational Expressions
3.7 Role of Relational Algebra and Relational Calculus in query optimization
3.8 Estimating Statistics of Expression
3.9 Choice of Evaluation Plans
3.10 Views and query processing
3.11 Storage and query optimization

PART-B

Unit 4: PostgreSQL

4.1 Important features and brief architecture
4.2 User Interfaces
4.3 SQL Variations and Extensions
4.4 Transaction Management
4.5 Storage and Indexing
4.6 Query Processing and evaluation and optimization

Unit 5: Object Oriented Database

5.1 Limitations of Relational databases
5.2 The need of Object oriented databases
5.3 Complex Data Types
5.4 Structured Types and Inheritance in SQL
5.5 Table Inheritance
5.6 Data types (arrays, multi-set etc) and structure in Object oriented databases using SQL
5.7 Object-Identity and Reference Types in SQL
5.8 ODL and OQL
5.9 Implementing O-R Features
5.10 Persistent Programming Languages
5.11 Object-Oriented versus Object-Relational
5.12 An Example of Object oriented and object relational database implementation

Unit-6: MongoDB

6.1 Document-oriented NoSQL database
6.2 MongoDB Architecture
6.3 CRUD, Schema Design
6.4 Data Modelling
6.5 Indexing using real-life case studies.

Text/Reference Books:

1. Database Management Systems Application Kogent Learning Solutions Inc. Dreamtech Press 2014, ISBN-978-93- 5119-476-7
2. Database System Concepts KorthHenery Tata McGraw Hill Education, 6111 Edition ,ISBN -13:978-93-329-0138-4
3. Complete Reference: MysqlVaswaniVikram McGraw Hill Education, ISBN-13: 9780070586840
4. SQL, PL/SQL The Programming Language of ORACLE Bayross Ivan BPB Publications, 3rd Edition ISBN-13: 978-8176569644

Software Required/Weblinks:

1. https://www.tutorialspoint.com
2. https://www.w3schools.com
3. http://db.ucsd.edu/static/csel32b-sp01/oql.htm

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-622A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-622A.1	3	2	2	2	3	-	2	-	2	3	-	1	2	3	2
BCS-DS-622A.2	2	3	3	2	3	2	3	-	-	3	3	2	3	-	-
BCS-DS-622A.3	2	2	3	2	3	-	2	2	2	2	-	-	2	2	2
BCS-DS-622A.4	3	2	3	2	2	3	2	3	2	2	2	2	2	-	-
BCS-DS-622A.5	2	2	3	2	3	-	2	3	2	2	3	2	2	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

BCS-DS-671A: Advance Data Base Management Systems Lab

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Database Management Systems Lab (BCS-DS-452)
Course Type: Program Electives

Course Outcomes: Students will be able to-
1. Apply the basic concepts of Database Systems and Applications.
2. Use the basics of SQL and construct queries using SQL in database creation and interaction.
3. Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.
4. Analyze and Select storage and recovery techniques of database system.
5. Design a no sql database system.

List of Practicals:
1. Design a Database and create required tables. For e.g. Bank, College Database
2. Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables.
3. Write a sql statement for implementing ALTER,UPDATE and DELETE
4. Write the queries to implement the joins
5. Write the query for implementing the following functions: MAX(),MIN(),AVG(),COUNT()
6. Write the query to implement the concept of Intergrity constrains
7. Write the query to create the views
8. Perform the queries for triggers
9. Perform the following operation for demonstrating the insertion,updation and deletion using the referential integrity constraints
10. Write the query for creating the users and their role.
11. Design and Develop MongoDB Queries using CRUD operations. (Use CRUD operations, SAVE method, logical operators)
12. Implement aggregation and indexing with suitable example using MongoDB.
13. Write a Program to build a menu driven application for Managing Bank Transactions Like Deposit, Withdrwal through MongoDB Database.
14. Build an application for Hotel with following features
    a) Maintaining Rooms Occupancy
    b) Adding Rooms
    c) Insert a "room" that has the name "Room 44" and size of "50" for a particular "house" that belongs to this user?

Software Required/Weblinks:

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance

Viva (Question and answers in lab)
End Semester Practical Exam

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-671A)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-671A.1	3	2	2	2	3	-	2	-	2	3	-	1	2	3	2
BCS-DS-671A.2	2	3	3	2	3	2	3	-	-	3	3	2	3	-	-
BCS-DS-671A.3	2	2	3	2	3	-	2	2	2	2	-	-	2	2	2
BCS-DS-671A.4	3	2	3	2	2	3	2	3	2	2	2	2	2	-	-
BCS-DS-671A.5	2	2	3	2	3	-	2	3	2	2	3	2	2	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-624: Complier Design

Periods/week Credits	Max. Marks : 200
L: 3 T: 0 3.0	Continuous Evaluation : 100
Duration of Examination: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-

BCS-DS-624.1. Describe the different phases of the compilation process
BCS-DS-624.2. Apply the formal attributed grammars for specifying the syntax and semantics of programming languages.
BCS-DS-624.3. Design scanner and parser using LEX tool & YACC tool.
BCS-DS-624.4. Identify different language translators.
BCS-DS-624.5. Interpret new code optimization techniques to improve the performance of a program in terms of speed & space.
BCS-DS-624.6. Employ the knowledge of patterns, tokens & regular expressions for solving a problem in the field of data mining.

PART- A

Unit-1: Concept of Programming language

1.1 Syntactic and semantic rules of a Programming language, Characteristics of a good programming language,
1.2 Specification & implementation of elementary data types,
1.3 Declarations, type checking & type conversions.
1.4 Implicit & explicit sequence controls
1.5 sequence control within expressions,
1.6 sequence control within statement,
1.7 Subprogram sequence control: simple call return,
1.8 recursive subprograms,
1.9 Names & referencing environment, static & dynamic scope,
1.10 Local data & local referencing environment,
1.11 Shared data: dynamic & static scope.
1.12 Parameter & parameter transmission schemes.

Unit–2: Lexical Analysis

2.1 structure of compiler and its different phases,
2.2 Compiler construction tools, Role of lexical analyzer
2.3 design and Implementation of lexical analyzer,
2.4 Regular expressions, Specification and recognition of tokens.
2.5 A language specifying lexical analyzer: LEX, Finite automata,
2.6 conversion from regular expression to finite automata, and vice versa,
2.7 minimizing number of states of DFA, input buffering,

Unit-3: Syntax Analysis

3.1. Context free grammars,
3.2. Role of parsers, definition of parsing,

3.3. Types of parsing. Parsing Technique: Top down parsing,
3.4. Predictive parsing
3.5. Operator precedence parsing,
3.6. Top down parsers, LR parsers, SLR
3.7. LALR and Canonical LR parser

PART- B

Unit-4: Syntax Directed Translations

4.1 Syntax directed definition, construction of syntax trees,
4.2 syntax directed translation scheme,
4.3 implementation of syntax directed translation.
4.4 three address code: quadruples, triples and indirect triples,

Unit-5: Symbol Table & Error Detection and Recovery

5.1 Symbol tables and its contents.
5.2 Data structures for symbol tables; trees, arrays,
5.3 linked lists, hash tables.
5.4 Errors, lexical phase error.
5.5 syntactic phase error, semantic error,
5.6 error recovery techniques,

Unit-6: Code Optimization & Code Generation

6.1 Code generation, forms of object code,
6.2 machine dependent code, optimization of intermediate codes,
6.3 register allocation for temporary and user defined variables,
6.4 code optimization.

Text Books / Reference Books:

1. A. V. AHO, Ravi Sethi & J.D. Ullman; 1998, Compilers Principle, Techniques & Tools, AW.
2. O.G.Kakde, 2015, Compiler Design, 4thEdition, Laxmi Publications
3. Tremblay & Sorenson, NA, 1985, Theory and Practice of Compiler writing, TMH.
4. K L P Mishra, 2006, Theory of computer science: Automata, Languages and computation,3rd edition, PHI

Software required/Weblinks:

C/C++(TurboC/DOS BOX)
www. 3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

(BCS-DS-624)															
BCS-DS-624.1	1	1	2	-	-	-	-	-	-	1	3	3	1	1	1
BCS-DS-624.2	2	1	-	-	3	1	-	-	-	2	-	-	1	2	-
BCS-DS-624.3	2	-	1	1	3	1	-	-	-	2	-	-	1	2	-
BCS-DS-624.4	1	-	-	-	-	-	2	-	-	-	2	2	-	-	1
BCS-DS-624.5	1	2	-	1	-	-	-	-	-	-	2	1	-	-	-
BCS-DS-624.6	1	-	3	-	-	-	-	-	-	-	-	2	2	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-673: Complier Design Lab

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Complier Design (BCS-DS-624)
Course Type: Program Electives

Course Outcomes: Students will be able to-
1. Recognize and effectively explain the working of Lexical Analyzer.
2. Understand the parsing techniques and their importance.
3. Develop program to solve complex problems in compiler.
4. Apply various data structures for storage allocation.
5. Learn the new code optimization techniques and apply it to improve the performance of a program in terms of speed & space.
6. Use new tools and technologies used for designing a compiler.

List of Practicals:
1. Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language.
2. Write a C program to identify whether a given line is a comment or not.
3. Write a C program to recognize strings under 'a', 'a*b+',' abb'.
4. Write a C program to test whether a given identifier is valid or not.
5. Write a C program to simulate lexical analyzer for validating operators.
6. Write a C program for construction of LL(1) parsing.
7. Write a C program to implement LALR parsing.
8. Write a C program to implement Program semantic rules to calculate the expression that takes an expression with digits, +and * and computes the value.
9. Implementation of symbol table.
10. Implement any one storage allocation strategies (Heap,Stack,Static).
11. Implementation of simple code optimization techniques (constant folding. etc.)
12. Design a linker & loader in real time environment.
13. Design a speech to text analyser.

Text Books / Reference Books:

1. Ullman, J.D. and Aho, A.V., 1977. Principles of compiler design. Reading: Addison Wesley.
2. Yashwant, K., 1999. Let us C. Array and pointers, 7th edition, BPB publication.

Software required/Weblinks:
C/C++
www.w3schools.com/sql
www.tutorialspoint.com/sql

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-673)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-673.1	2	2	1	2	3	2	2	1	2	2	2	3	2	2	2
BCS-DS-673.2	3	2	2	2	3	2	3	2	2	3	3	3	2	2	2
BCS-DS-673.3	2	1	2	1	3	3	1	1	2	1	2	2	2	2	2
BCS-DS-673.4	1	3	2	3	3	1	1	1	2	1	3	3	2	2	2
BCS-DS-673.5	1	1	1	3	1	2	3	1	3	1	1	3	2	2	3
BCS-DS-673.6	1	1	3	1	3	3	3	2	3	3	1	3	1	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-676: Web Development Framework

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-676.1. Understand the content management systems to create and host modern websites.
BCS-DS-676.2. Use open source content management systems (CMS) on the web today, including WordPress, Drupal, and Joomla.
BCS-DS-676.3. Learn to use a Drupal site as a user with varying rights, optionally, install a Drupal site.
BCS-DS-676.4. Analyze the benefits of working with a server-side database and the power it brings to creating and managing websites.
BCS-DS-676.5 Create and deploy websites using CMS, including creating and editing content, adding functionality, and creating custom templates and themes.
BCS-DS-676.6 Learn ongoing maintenance considerations with CMS websites.

Note: The faculty members are required to make sure that all the students perform at least one experiment related to the topics mentioned. In addition to this the faculty teaching the course, is required to make students identify a project during the initial lectures, and let students implement the concepts learned, as the course progresses. The evaluation should be only on the basis of, how complex the objectives were set and how much percentage of the same have been implemented in the final project, in the efficient manner.

PART-A

Unit-1: Introduction
1.1 What is CMS? Types of CMS, CMS Architecture.
1.2 CMS Technologies: LAMP stack, Web server (Apache), Database (MySQL).
1.3 Scripting languages- HTML, CSS, JavaScript, and PHP.
1.4 Website strategy and planning, site mapping, content planning.

Unit-2: Wordpress
2.1 Case Study: Wordpress – Architecture, Modules.
2.2 Themes, Installation and Configuration.
2.3 Modifying WordPress CSS and HTML parameters.
2.4 Plug-ins and themes Best Practices.

Unit-3: Drupal
3.1 Case Study: Drupal Terminology, Architecture Installation and Configuration Modules.
3.2 Themes Data Abstraction Layer, Content Types – CCK, Views Best Practices
3.3 Adjust the default image settings, or create your own image styles.
3.4 Apply the image styles to content types that use image fields.

PART-B

Unit-4: Joomla
4.1 Installing Joomla, Exploring the Admin Interface, Content creation using the CAM model
4.2 Content customization: images, video, audio, tags, formats, etc.
4.3 Adding and displaying menus, Linking menus to articles and other features, Finding and adding Joomla extensions
4.4 Adding and setting up 2 "big" extensions (choose blog, calendar, image gallery, Paypal-based shopping cart, or portfolio. Other extensions on approval).

Unit-5: Django
5.1 Introduction to Django, Installation, Overview.

5.2 Virtual Environment, Overview & Creating App
5.3 Views: URL Mapping/ URL Dispatcher, Regular expressions, Error/Exception handling, Decorators.
5.4 Templates: Django Template language, Filters: Models, Fields: Queries [with Filters] Migrations Forms: Validations, Fields & Widgets Authentication & Administration.

Unit-6: Laravel
6.1 Introduction, Laravel Features, LARAVEL INSTALLATION.
6.2 APPLICATION STRUCTURE of Laravel: Root Directory App Directory.
6.3 CONFIGURATION: Basic Configuration Environmental Configuration, Database Configuration, Naming the Application, Maintenance Mode.

Software Required/Weblinks:
"Divi Framework, by Elegant Themes." Accessed January 12, 2016.
http:// www.elegantthemes.com. "Drupal.org." Accessed January 12, 2016.
https://www.drupal.org. "Grav, a Modern Flat-file CMS." Accessed January 12, 2016.
https://getgrav.org. "Wordpress.org." Accessed January 12, 2016. https://wordpress.org.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-676)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-676.1	3	-	-	-	3	1	1	2	3	1	2	3	3	2	-
BCS-DS-676.2	3	2	3	2	3	3	3	2	3	3	-	3	3	3	2
BCS-DS-676.3	3	3	3	1	3	1	-	2	3	3	-	3	3	3	2
BCS-DS-676.4	3	3	3	1	3	1	-	2	3	3	-	3	3	3	2
BCS-DS-676.5	1	-	-	-	-	3	-	3	-	3	-	3	-	-	-
BCS-DS-676.6	3	1	2	3	3	3	-	2	3	3	-	3	3	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-632: Data Mining

Periods/week Credits	Max. Marks	: 200
L: 3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Database Management Systems (BCS-DS-404)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-632.1. Identify appropriate data mining algorithms to solve real world problems.
BCS-DS-632.2. Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining.
BCS-DS-632.3. Describe complex data types with respect to spatial and web mining.
BCS-DS-632.4. Develop skills to write queries using DMQL
BCS-DS-632.5. Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

PART-A

Unit 1: Data Mining & Business Intelligence:
1.1 Introduction: Scope of Data Mining: What is Data Mining;
1.2 How does Data Mining Works, Predictive Modeling:
1.3 Data Mining and Data Warehousing: Architecture for Data Mining:
1.4 Profitable Applications: Data Mining Tools,
1.5 Business Intelligence, Business Intelligence tools,
1.6 Business Intelligence Infrastructure, Business Intelligence Applications,
1.7 BI versus Data Warehouse, BI versus Data Mining, Future of BI.

Unit 2: Data Preprocessing:
2.1 Introduction, Data Preprocessing Overview,
2.2 Data Cleaning, Data Integration and Transformation,
2.3 Data Reduction, Discretization
2.4 Concept Hierarchy Generation.

Unit 3: Data Mining Techniques- An Overview:
3.1 Introduction, Data Mining,
3.2 Data Mining Versus Database Management System,
3.3 Data Mining Techniques-
3.4 Association rules, Classification, Regression,
3.5 Clustering, Neural networks.

PART-B

Unit 4: Clustering:
4.1 Introduction, Clustering,
4.2 Cluster Analysis,
4.3 Clustering Methods- K means, Hierarchical clustering,
4.4 Agglomerative clustering, Divisive clustering,
4.5 Clustering and segmentation software, evaluating clusters.

Unit 5: Web Mining:
5.1 Introduction, Terminologies,
5.2 Categories of Web Mining – Web Content Mining,
5.3 Web Structure Mining,
5.4 Web Usage Mining,
5.5 Applications of Web Mining, and Agent based and Data base approaches,
5.6 Web mining Software.

Unit 6: Applications of Data mining:
6.1 Introduction, Business Applications Using Data Mining
6.2 Risk management and targeted marketing,
6.3 Customer profiles and feature construction,
6.4 Medical applications (diabetic screening),
6.5 Scientific Applications using Data Mining, Other Applications.

Text Books / Reference Books:

1. Arun Pujar, 2010, Data Mining Techniques, 2nd Edition, Orient Black Swan/ Universities Press.
2. Alex Berson, 2004, Data Warehousing, Data Mining and OLTP, 1st Edition, MGH.
3. W.H. Inman, 2005, Building the Data Warehouse, 4th Edition, John Wiley & Sons.
4. W.H Ionhman, C.Klelly, 1993, Developing the Data Warehouses, John Wiley & Sons.
5. Sourav S Bhowmick , Sanjay K Madria , Wee K Ng , Hardcover,2003, Web Data Management, Springer.
6. Pieter Adriaans & Dolf Zantinge, 1997, Data Mining, Pearson,

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Sem examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-632)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-632.1	3	-	2	-	1	2	1	-	2	1	1	1	-	1	2
BCS-DS-632.2	-	2	3	2	-	1	1	1	-	1	1	2	-	2	-
BCS-DS-632.3	3	-	2	-	1	1	-	2	2	-	2	3	1	-	1
BCS-DS-632.4	2	-	1	3	3	-	2	-	1	-	1	-	2	1	1
BCS-DS-632.5	-	2	3	2	2	-	-	1	-	1	-	-	3	1	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BCS-DS-682: Data mining Lab using WEKA

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Data Mining (BCS-DS-632)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-682.1. Relate the concept of loading, preprocessing, and analysis of large data sets.
BCS-DS-682.2. Describe the concept of various classification models and also draw a connection between these models.
BCS-DS-682.3. Implement various clustering techniques and also draw a connection between these techniques.
BCS-DS-682.4. Able to apply and explore the ideas and find association among data .
BCS-DS-682.5. Design and analyze new models to solve various real world problems.
BCS-DS-682.6. Plan and generate alternate solution to the existing framework and also study and analyze the results through data visualization.

Program 1: Use Boston *House Price Dataset* i.e. *housing.arff*. Apply all preprocessing algorithms and create a version of the initial data set in which the categorical data are converted into numerical data.
Program 2: Use all the above algorithms to classify weather data from the "weather.arff" file. Perform initial preprocessing and create a version of the initial dataset in which all numeric attributes should be converted to categorical data.
Program 3: Use k-means algorithm to bank data from the "bank.arff" file. Perform initial preprocessing and create a version of the initial data set in which the ID field should be removed and the "children" attribute should be converted to categorical data.
Program 4: Use Apriori algorithm to generate association rules for Iris data from the "iris.arff" file. Perform preprocessing and convert categorical data into numeric attributes and analyze results.
Program 5: Use "vote.arff" file for the processing of various attribute selection algorithm and evaluation of various performance measures.
Program 6: Use "diabetes.arff" file to evaluate various performance parameters for any three classifiers. Then generate and display the comparison graph for all the above performance parameters through various charts or graphs.
Program 7: Design and create an ensemble model using more than one classification algorithms (Bagging and Boosting)
Program 8: Design and create an ensemble model using more than two classification algorithms (Boosting).
Program 9: Design a Project for the Analysis and Identification handwritten digits using neural network model behavior.
Program 10: Design a Project for the Analysis and Prediction of student's behavior using suitable algorithms.

Text Books/ Reference Books:

1. Bostjan Kaluza, 2013, Instant Weka How-to, Packt Publishing
2. Eric Goh, 2019, Learn By Examples - A Quick Guide to Data Mining with Weka and Java using Weka, SVBook Pte. Ltd.
3. Eric Goh, 2019, Learn By Examples - A Quick Guide to Data Mining with Rapid miner and Weka, SVBook Pte. Ltd.

Software required/Weblinks:
WEKA 3.8.3
www.cs.wakato.ac.nz
http://wekatutorial.com
www.tutorialspoint.com

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-682)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-682.1	3	3	3	3	1	1	1	1	1	1	1	1	1	1	1
BCS-DS-682.2	3	3	3	3	3	3	2	1	3	2	2	3	3	2	2
BCS-DS-682.3	3	3	3	3	3	3	2	1	3	2	2	3	3	2	2
BCS-DS-682.4	3	3	3	3	3	3	2	1	2	2	2	3	3	2	2
BCS-DS-682.5	3	3	3	3	3	3	2	1	3	1	3	3	3	2	3
BCS-DS-682.6	3	3	3	3	3	3	2	1	2	1	3	3	3	2	3

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BCS-DS-647: Computing Service: Eclipse

Periods/week Credits	Max. Marks	: 200
L: 3 T: 0 3.0	Internal	: 100
Duration of Examination: 3 Hrs	External	: 100

Pre-Requisite: NIL
Course Type: Elective
Course Outcomes: The students will be able to-
BCS-DS-647.1 to learn the various types of computing services and their role in building scalable and distributed applications
BCS-DS-647.2 to navigate the IDE, manage projects, write and debug code, and utilize advanced features and plugins provided by Eclipse.
BCS-DS-647.3 to develop client-server applications using Java sockets.
BCS-DS-647.4 to build web services using Java technologies.
BCS-DS-647.5 To deploy Java applications to cloud platforms such as AWS, Azure, or Google Cloud using Eclipse

PART –A

Unit-1: Introduction to Computing Services and Java
1.1 Overview of computing services and their importance in modern software development,
1.2 Introduction to Java programming language and its role in building computing services.
1.3 Setting up Eclipse IDE for Java development

Unit-2 Managing Computing Projects in Eclipse
2.1Code editing and formatting in Eclipse,
2.2.Debugging Java programs in Eclipse,
2.3Building and managing dependencies with Maven or Gradle,
2.4.Unit testing with JUnit and integrating it into Eclipse.,
2.5 Working with Java libraries and frameworks to implement applications including JDBC, Servlets,JSP in Eclipse.
2.6Exploring popular Eclipse plugins for specific domains (e.g., web development, Android, enterprise).

Unit -3 Networking and Communication:
3.1 Introduction to networking concepts and protocols,
3.2 Socket programming in Java for network communication.,
3.3 Implementing client-server applications using TCP/IP or UDP protocols.,
3.4 Handling network communication errors and exceptions.

Unit-4 : Web Services Development:
4.1 Understanding web services and their architectures (SOAP, RESTful)
4.2 Building SOAP-based web services using Java technologies (JAX-WS, Apache Axis)
4.3 Implementing RESTful web services using Java frameworks (JAX-RS, Spring Boot),
4.4 Testing and debugging web services in Eclipse

Unit-5 Cloud Computing and Java:
5.1 Introduction to cloud computing models (IaaS, PaaS, SaaS) and cloud service providers (AWS, Azure, Google Cloud).
5.2 Deploying Java applications to the cloud using containers (Docker) and container orchestration (Kubernetes),
5.3 Implementing cloud-native architectures using Java frameworks like Spring Cloud.

Unit-6: Security in Computing Services:
6.1 Fundamentals of secure computing services,
6.2 Authentication, authorization, and encryption techniques,
6.3 Implementing secure communication protocols (HTTPS) in Java applications.,
6.4 Handling security vulnerabilities and best practices in Java development.

Text Books / Reference Books:

1. "Eclipse IDE Pocket Guide" by Ed Burnette

2. Eclipse 4 RCP by Lars Vogel
3. Java EE Development with Eclipse Second Edition by Ram Kulkarni

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX :

CO Statement	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-647.1	1	2	3	2	2	2	2	-	-	-	-	-	-	-	-
BCS-DS-647.2	2	2	2	2	3	3	3	3	3	3	-	-	-	-	-
BCS-DS-647.3	-	2	3	2	2	2		3	3	3	-	-	-	-	-
BCS-DS-647.4	-	-	-	-	-	-	1		2	3	2	2	2	-	-
BCS-DS-647.5	3	3	3	3	3	3	-	-	-	-	-	-	-	-	-

NAAC 'A++' Grade University

BCS-DS-648 : Digital Service Innovation

Periods/week	Credits	Max. Marks	: 200
L : 3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: NIL

Course Type: Elective

Course Outcomes: The students will be able to-

BCS-DS-648.1 Describe different approaches to innovation processes.
BCS-DS-648.2 Explain & Analyze digital innovation processes.
BCS-DS-648.3 Evaluate and develop digital innovation processes.
BCS-DS-648.4 Reflect on the opportunities and risks associated with digital innovation processes.
BCS-DS-648.5 Servitization investigated using digital service innovations (DSIs).

PART-A

Unit-1: Digital Service Innovation and Digital Products with Law Concepts

1.1 Service Innovation In The Digital Age Service Innovation
1.2 Digital Innovations and Developments as Knowledge Assets – IP Laws,
1.3 Cyber Law and Digital Content Protection – Unfair Competition
1.4 Meaning and Relationship between Unfair Competition and IP Laws - Case Studies.

Unit-2: Digital Transformation

2.5 Digital Transformation & Channel Attribution
2.6 Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis
2.7 Recent trends in Digital marketing

Unit-3: Technology Absorption and Innovation

3.1 Present status in India & Need for new outlook
3.2 Absorption strategies for acquired technology
3.3 Creating new/improved technologies & Innovations
3.4 Technology, Measurement- Technology Audit.

PART-B

Unit-4: Digital Finance and Alternative Finance

4.1 A Brief History of Financial Innovation
4.2 Digitization of Financial Services
4.3 Crowd funding, Charity and Equity.
4.4 Introduction to the concept of Initial Coin Offering.

Unit-5: Digital Forensics

5.1 The Digital Forensics Process – Introduction
5.2 The Identification Phase – The Collection Phase – The Examination Phase
5.3 The Analysis Phase – The Presentation Phase

Unit-6: Digital Innovative Capability & Applications

6.1 Innovative Platforms in the Industry: a Value Creation Perspective in a Large Corporation
6.2 Digital Capability - Investigating Co-evolution of IT and Business Strategies
6.3 The role of users and customers in digital innovation: Insights from B2B manufacturing firms
6.4. Design Capital and Design Moves: The Logic of Digital Business Strategy

Text Books/ Reference Books:

1. James A.Senn, "Information technology in Business", Prentice Hall, 1995
2. Gerard H. Gaynor, "Handbook of Technology Management", McGraw-Hill Professional, 1996

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-648)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-648.1	2	1	2	-	-	2	1	2	2	2	3	-	-	-	-
BCS-DS-648.2	2	2	2	-	-	3	2	3	2	3	3	-	-	-	-
BCS-DS-648.3	1	2	1	-	-	1	1	3	1	3	3	-	-	-	-
BCS-DS-648.4	3	2	2	-	-	1	1	2	1	2	2	-	-	-	-
BCS-DS-648.5	3	2	2	-	-	1	1	2	1	2	2	-	-	-	-

NAAC 'A++' Grade University

BCS-DS-649: Cognitive Modelling

Periods/week Credits		Max. Marks : 200
L :3 T:0 3.0	Continuous Evaluation : 100	
Duration of Exam: 3 Hrs	End Sem Examination : 100	

Pre-Requisite: NIL
Course Type: Elective
Course Outcomes: The students will be able to-

BCS-DS-649.1: To identify and Evaluate the applicability of cognitive modeling in different human-computer interaction scenarios.
BCS-DS-649.2: To describe, analyze and apply cognitive modeling techniques to optimize interface elements for better perception and attention.
BCS-DS-649.3: To synthesize the interfaces that enhance information processing and reduce cognitive load based on cognitive modeling techniques.
BCS-DS-6 49.4: To apply cognitive modeling to design interfaces that support effective decision making and problem solving.
BCS-DS-649.5: To design interfaces that facilitate learning and skill acquisition based on cognitive modeling techniques.
BCS-DS-649.6: To conduct usability tests and cognitive walkthroughs to assess interface design.

PART A

Unit 1: Introduction to Cognitive Modeling and Human-Computer Interaction

1.1 Introduction to cognitive modeling and its applications in human-computer interface design.
1.2 Overview of the key theories and models in cognitive science and their relevance to human-computer interaction.
1.3 Examination of the role of cognitive modeling in improving user experience and interface design.

Unit 2: Perception and attention

2.1 Understanding human perception and attentional processes.
2.2 Theories and models of visual perception and their implications for interface design.
2.3 Attentional mechanisms and their impact on interface usability.
2.4 Applying cognitive modeling techniques to optimize interface elements for better perception and attention.

Unit 3: Memory and Information Processing

3.1 Overview of human memory systems and information processing.
3.2 Models of human memory and their implications for interface design.
3.3 Cognitive load theory and its relevance to interface design.
3.4 Designing interfaces to enhance information processing and reduce cognitive load

PART B

Unit 4: Decision making and Problem solving

4.1 Theories and models of decision making and problem solving.
4.2 Rational and heuristic decision-making approaches and their impact on interface design.
4.3 Cognitive biases and their implications for interface design.
4.4 Applying cognitive modeling to design interfaces that support effective decision making and problem solving.

Unit 5: Learning and skill Acquisition

5.1 Theories of learning and skill acquisition.
5.2 Cognitive modeling approaches to studying learning and skill acquisition.
5.3 The role of feedback and reinforcement in interface design.
5.4 Designing interfaces that facilitate learning and skill acquisition.

Unit 6: User Experience and Evaluation

6.1 Understanding user experience and its components.
6.2 Cognitive modeling techniques for evaluating user experience.
6.3 Conducting usability tests and cognitive walkthroughs.
6.4 Using cognitive modeling to improve user experience and interface design.

References:

1. "Cognitive Psychology: Connecting Mind, Research, and Everyday Experience" by E. Bruce Goldstein
2. "Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Rules" by Jeff Johnson
3. "Cognitive Science: An Introduction to the Study of Mind" by Jay D. Friedenberg and Gordon W. Silverman
4. "Interaction Design: Beyond Human-Computer Interaction" by Jennifer Preece, Yvonne Rogers, and Helen Sharp
5. "Thinking, Fast and Slow" by Daniel Kahneman
6. "Cognitive Modeling in Perception and Memory: A Festschrift for Richard M. Shiffrin" edited by Timothy T. Rogers and James L. McClelland
7. "The Cambridge Handbook of Applied Perception Research" edited by Robert R. Hoffman, P. A. Hancock, Mark W. Scerbo, Raja Parasuraman, and James L. Szalma
8. "Human-Computer Interaction: Overview, Fundamentals, and Methods" by Julie A. Jacko and Andrew Sears
9. "Cognitive Psychology and its Implications" by John R. Anderson

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

CO Statement (BCS-DS-649)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-649.1	2	1	2	-	-	2	1	2	2	2	3	-	-	-	-
BCS-DS-649.2	2	2	2	-	-	3	2	3	2	3	3	-	-	-	-
BCS-DS-649.3	1	2	1	-	-	1	1	3	1	3	3	-	-	-	-
BCS-DS-649.4	3	2	2	-	-	1	1	2	1	2	2	-	-	-	-
BCS-DS-649.5	2	1	2	2	2	-	-	-	-	-	-	-	-	-	-
BCS-DS-649.6	3	2	2	-	-	1	1	2	1	2	2	-	-	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A++' Grade University
BCS-DS-650 : Ubiquitous Computing

Periods/week Credits Max. Marks : 200

L : 3 T: 0 3.0 | Continuous Evaluation : 100
Duration of Exam: 3 Hrs | End Sem Examination : 100

Pre-Requisite: NIL
Course Type: Elective
Course Outcomes: The students will be able to-

BCS-DS-650.1: Describe the characteristics of pervasive computing applications including the basic computing application problems, performance objectives and quality of services, major system components and architectures of the systems.
BCS-DS-650.2: Analyze the strengths, problems and limitations of the current tools, devices and communications for pervasive computing systems.
BCS-DS-650.3: Recognize the different ways that humans will interact with systems in a ubiquitous environment and account for these accordingly
BCS-DS-650.4: List and exemplify the key technologies involved in the development Ubicomp systems
BCS-DS-650.5: Develop an attitude to identify and propose solutions for security and privacy issues.
BCS-DS-650.6: Explore the trends and problems of current pervasive computing systems using examples.

PART-A

Unit 1: Introduction to Ubiquitous Computing
1.1 Concept of Distributed Computing,
1.2 Mobile Computing,
1.3 Pervasive Computing,
1.4 Wearable Computing,
1.5 Modeling the Key Ubiquitous/Pervasive Computing Properties,
1.6 Mobile Adaptive Computing ,
1.7 Mobility Management and Caching

Unit 2: Pervasive Computing Devices
2.1 Smart Environment: CPI and CCI Smart Devices
2.2 Application and Requirements,
2.3 Device Technology and Connectivity,
2.4 Human Computer Interaction

Unit 3: Human Computer Interaction
3.1 Explicit HCI and Implicit HCI,
3.2 User Interface
3.3 Interaction for four hand-held widely used devices,
3.4 Hidden UI via basic smart devices,
3.5 Hidden UI via wearable and Implanted devices,
3.6 Human centered design, user models

Unit 4: Middleware for Pervasive Computing
4.1 Adaptive middleware,
4.2 Context aware middleware,
4.3 Mobile middleware,
4.4 Service Discovery,
4.5 Mobile Agents

Unit 5: Security in Pervasive Computing
5.1 Security and Privacy in Pervasive Networks,
5.2 Experimental Comparison of Collaborative Defense Strategies for Network Security

Unit 6: Challenges and Outlook
6.1 Overview of challenges,
6.2 Smart devices and smart interaction
6.3 Smart physical environment device interaction,
6.4 Smart human-device interaction,
6.5 Human Intelligence versus machine intelligence, social issues,
6.6 Case Study- Wearable Computing/ Cyber Physical System

Text Books/ Reference Books:

1. Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtor, Thomas Schaeck, "Pervasive Computing," Pearson, Eighteenth Impression, 2014.

2. Stefan Poslad, "Ubiquitous Computing, Smart devices, environment and interaction," Wiley.

3. Frank Adelstein, Sandeep Gupta, Golden Richard III, Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing," Tata McGraw Hills.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-650)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-650.1	3	2	1	2	2	3	2	1	2	2	2	3	2	2	3
BCS-DS-650.2	3	2	2	2	2	3	3	2	2	2	3	3	3	3	2
BCS-DS-650.3	2	1	2	1	2	2	1	1	2	1	3	3	3	2	2
BCS-DS-650.4	1	3	2	2	3	1	1	1	2	1	2	2	2	2	3
BCS-DS-650.5	2	1	2	1	2	2	1	1	1	1	1	3	3	2	2
BCS-DS-650.6	1	3	2	2	1	1	1	1	2	1	2	2	2	2	3

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HM-606 : French-2

Periods/week Credits	Max. Marks : 100
L: 2 T: 0 2.0	Continuous Evaluation : 50
Duration of Examination: 1.5 Hrs	End Sem Examination : 50

Pre-Requisites: Basic knowledge of grammatical structure, syntax, and vocabulary of French
Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-

HM-606.1. Exchange greetings and do introductions using formal and informal expressions. Understand and use interrogative and answer simple questions.

HM-606.2. Learn basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed.

HM-606.3. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.

HM-606.4. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary. Provide basic information about familiar situations and topics of interest.

HM-606.5. Express or/and justify opinions using equivalents of different verbs. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture.

HM-606.6. Describe various places, location, themselves using simple sentences and vocabulary.

PART – A

Unit 1- Se présenter (1)
1.1 Les pluriels
1.2 Adjectives to describe a person

Unit 2- Se présenter (2)
2.1 Professions
2.2 Short essay on family & friend
2.3 Comprehension

Unit 3- Parler de ses habitudes quotidiennes
3.1 Les verbes pronominaux
3.2 Décrivez votre journée

PART – B

Unit 4- Nommez et localiser des lieux dans la ville
4.1 Prepositions
4.2 Asking & telling the way

Unit 5- Informations simples sur le climat, la météo
5.1 Les saisons
5.2 Les expressions de la saison
5.3 Comprehension

Unit 6- Demander/ indiquer les horaires et les couleurs
6.1 Timings
6.2 Colours

Text Books/Reference Books/ Suggested Readings:

1. Annie Berthet, Catherine Hugot, Veronique M Kizirian,2006, Alter Ego Level One Textbook, Hachette Publications.
2. Mahitha Ranjit, 2016, Apprenons Le Francais II & III, Saraswati Publications.

Weblinks:
www.bonjourfrance.com
www.allabout.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores
Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM–606)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
HM-606.1	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-606.2	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-606.3	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-606.4	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-606.5	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-606.6	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1

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HM-607: GERMAN – 2

Periods/week Credits	Max. Marks	: 100
L: 2 T: 0 2.0	Continuous Evaluation	: 50
Duration of Examination: 1.5 Hrs	End Sem Examination	: 50

Pre-Requisites: Students are expected to have basic knowledge of German grammar. They should know regular verbs and conjugations. They should be able introduce themselves and make small sentences in German language.
Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-
HM-607.1. Discuss about various directions, countries and languages they speak.
HM-607.2. Write short essays on family and friends. They will have knowledge of tenses.
HM-607.3. Identify classroom vocabulary in the German language.
HM-607.4. Speak ordinal and cardinal numbers and they will also learn months, days in German.
HM-607.5. Express or/and justify opinions using equivalents of different verbs.
HM-607.6. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.

PART – A

Unit 1: Ordinal und Kardinal Zahlen,
1.1 Ordinal & Cardinal numbers
1.2 Months, days, Feiertage and dates

Unit 2: sein und haben
2.1 Verbs: to be and to have
2.2 helping verbs practice worksheets
2.3 Vocabulary (Family) short essay on family, friends etc.

PART – B

Unit 3: Gegenstände im Kursraum
3.1 Vocabulary (classroom)
3.2 Definite and indefinite articles

Unit 4: Länder, Sprachen
4.1 Countries, languages, directions
4.2 Past of the verb 'to be'

Text Books/Reference Books:
1. Rita Maria Niemann,Cornelsen, 2005, Studio d A1: Deutsch alsFremdsprache, Volume 6.
2. Dallapiazza, Rosa-Maria and Jan, Eduard von. Tangram aktuell 1. Deutsch alsFremdsprache Tangram aktuell 1 - Lektion 1-4: Deutsch als. (HueberVerlag, 2005).
3. Dallapiazza, Rosa-Maria and Jan, Eduard von. Tangram aktuell 1. Deutsch alsFremdsprache Tangram aktuell 1 - Lektion 5-8: Deutsch als. (HueberVerlag, 2005).
4. Paul Rusch, 2015: Langenscheidt and Klett.

Weblinks:
http://www.nthuleen.com/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores
Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM–607)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
HM-607.1	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-607.2	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-607.3	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-607.4	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-607.5	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-607.6	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1

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HM-608: SPANISH – 2

Periods/week Credits	Max. Marks	: 100
L: 2 T: 0 2.0	Continuous Evaluation	: 50
Duration of Examination: 1.5 Hrs	End Sem Examination	: 50

Pre-Requisites: Students are expected to have basic knowledge of Spanish Grammar. They should be able to understand Spanish language along with basic skills for communication. Students are also expected to have basic knowledge of Spanish Culture.
Course Type: Humanities and Social Sciences

Course Outcomes: Students will be able to-
HM-608.1. Know about various color names in Spanish along with various vocabularies related to cloths and wardrobe.
HM-608.2. Differentiate between Ser and Estar verbs along with uses.
HM-608.3. Understand adjectives along with telling time.
HM-608.4. Learn Count till 1000
HM-608.5. Acquire knowledge of regular –ER and –IR verbs along with its various uses.
HM-608.6. Assess knowledge of vocabulary related to family and marital status.

PART – A

Unit 1 : Color and Clothing
1.1 Introduction of colors
1.2 Vocabulary related to clothes and wardrobe

Unit 2 : Ser, Estar and Haber
2.1 Difference between the use of Verbo SER and ESTAR and their use with the similar adjective.
2.2 Introduction of Verbo HABER

PART – B

Unit 3 : Adjective, Counting and Time
3.1 Demonstrative adjectives
3.2 Counting till 1000
3.3 Time

Unit 4 : Verb ER and IR and Family
4.1 Introduction and Usage of –ER Verbs
4.2 Introduction and Usage of –IR Verbs
4.3 Vocabulary related to the family and marital status

Text Books/Reference Books:

1. Eric V Greenfield, 1971, Barnes and Noble.
2. Nuevo Espanol sin fronteras, Jesus Sanchez Lobato and Isabel Santos Gargallo, 2005, Goyal Saab, ELE & SGEL.

Weblinks:
http://studyspanish.com/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Student needs to attempt four questions from the remaining six questions. Five questions need to be attempted in total. Each question will be of 10 marks.

Evaluation Tools:
Sessional tests
End Semester Examination scores

Participation in class activities
Home assignments
Class attendance

COURSE ARTICULATION MATRIX :

CO Statement (HM-608)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
HM-608.1	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-608.2	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-608.3	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-608.4	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1
HM-608.5	-	-	-	-	-	1	-	-	1	1	-	1	-	-	1
HM-608.6	-	-	-	-	-	1	-	-	1	1	-	-	-	-	1

SEMESTER – VII

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PROJ-CS-700: Project Phase - II/Industrial Project

Periods/week Credits Max. Marks : 300
P :10 5.0 Continuous Evaluation : 200
Duration of Examination: 2 Hrs End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Projects

Course Outcomes: Students will be able to-
PROJ-CS-700.1. Indentifies real world problems related to systems development decisions, originating from source requirements and goals.
PROJ-CS-700.2. Design models as a solution for particular problems.
PROJ-CS-700.3. Employ his/her skills in emerging areas.
PROJ-CS-700.4. Manage work in team or group.
PROJ-CS-700.5. Apply his/her learning in testing techniques
PROJ-CS-700.6. Implement skilled solutions in various platforms.

The project is guided by a faculty. The projects are to be individual or in group. The work plan is be finalized prior to the semester.

Text Books / Reference Books:
1. Harold Kerzner, 2013, Project Management: A Systems Approach to Planning, Scheduling, and Controlling; 11th edition, WILEY.
2. Gregory M. Horine, 2012, Project Management Absolute Beginner's Guide; Third Edition, Que.

Software required/Weblinks:
Ieee.org
www.tutorialpoint.com
www.nptel.com

Distribution of Continuous Evaluation:

Presentation/Viva	40%
Report	20%
Class Work/ Performance	20%
Attendance	20%

Evaluation Tools:
Presentation/Implementation

COURSE ARTICULATION MATRIX:

CO Statement (PROJ-CS-700)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
PROJ-CS-700.1	1	3	2	1	3	-	1	1	3	-	1	1	3	2	3
PROJ-CS-700.2	-	1	-	-	1	1	2	1	-	1	-	1	1	1	-
PROJ-CS-700.3	-	1	2	-	-	1	-	-	-	-	2	-	-	-	3
PROJ-CS-700.4	1	-	-	1	2	-	1	2	1	2	-	1	-	-	-
PROJ-CS-700.5	-	2	1	-	3	1	-	-	1	-	2	-	1	-	1
PROJ-CS-700.6	1	-	-	1	-	-	-	1	-	3	-	1	-	1	-

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PROJ-CS-710: Summer Internship-III

Periods/week Credits — Max. Marks : 200
L : 2 T: 0 2.0 — Continuous Evaluation : 100
Duration of Exam: — End Sem Examination : 100

Pre-Requisite: Summer Internship-II
Course Type: Core
Course Outcomes: The students will be able to-
Proj-CS-710.1. Actually face challenges of real field work.
Proj-CS-710.2. Apply their learning skills to solve real life problem.
Proj-CS-710.3. Show the research capability.
Proj-CS-710.4. Enhance their Innovative skills.
Proj-CS-710.5. Develop solutions.
Proj-CS-710.6. Build technology for new areas.

Every student will have to undergo summer internship for 10 weeks in the relevant field of Engineering in which he/she is enrolled for B.Tech programme after 6^{th} semester. Respective Head of Department will approve the Industry/Organization for internship. During this course of time he/she will be regularly monitored and evaluated. After successful completion of the internship, the student will have to submit the internship report, deliver a seminar about the work/project undertaken during the internship and will have to appear for viva. The evaluation of the summer internship shall be made as per following:

Continuous Evaluation during training:
1. Evaluation by the Supervisor in the Industry : 50 marks
2. Evaluation by Faculty Mentor during training visit : 20 marks
3. Internal seminar/ Presentation : 30 marks

Total Marks : **100**

End Term Evaluation after training:
1. Project Report : 20 marks
2. Seminar/Presentation : 40 marks
3. Viva : 40 marks

Total marks **100**

Total Credits : 2
COURSE ARTICULATION MATRIX :

CO Statement (Proj-CS-500)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
Proj-CS-710.1	1	2	3	-	-	-	2	2	3	3	2	3	1	2	3
Proj-CS-710.2	1	3	3	-	-	-	2	3	3	2	2	3	1	2	3
Proj-CS-710.3	2	-	-	-	-	-	2	1	2	3	2	3	1	2	3
Proj-CS-710.4	1	-	-	-	-	-	2	1	3	3	2	3	1	2	2
Proj-CS-710.5	2	-	-	-	-	-	2	2	3	2	2	3	2	-	3
Proj-CS-710.6	1	-	-	-	-	-	2	2	3	2	2	3	1	2	3

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BCS-DS-707: DEVOPS

Periods/week Credits	Max. Marks : 200
L :3 T: 0 3.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Basic Knowledge of software engineering
Course Type: Program Core
Course Objective:
1. To introduce the new concept Developers and Operators as a combination
2. To Introduce of the purpose of the DevOps

Course Outcomes: The students will be able to-

BCS-DS-707.1: Explain traditional software development methodologies like waterfall and apply the Agile Methodology and comparing various other software development models with agile.
BCS-DS-707.2: Explain implementing Continuous Integration and Continuous Delivery
BCS-DS-707.3: Create quick MVP prototypes for modules and functionalities.
BCS-DS-707.4: Understand different kinds of DevOps tools
BCS-DS-707.5: Define CAMS for DevOps (Culture, Automation, Measurement and Sharing).

Unit1: Traditional Software Development and Agile Methodologies

1.1 Introduction to Software Engineering, Waterfall method, Developers vs IT Operations conflict , History of Agile,
1.2 Agile Vs Waterfall Method, Iterative Agile Software Development, Individual and team interactions over processes and tools,
1.3 Working software over comprehensive documentation, Customer collaboration over contract negotiation, Responding to change over following a plan.

Unit2: Definition of DevOps

2.1 Introduction to DevOps, DevOps and Agile, DevOps Market Trends,
2.2 DevOps Engineer Skills, DevOps Delivery Pipeline, DevOps Ecosystem

Unit3: Purpose of DevOps

3.1 Minimum Viable Product, Application Deployment,
3.2 Continuous Integration, Continuous Delivery

Unit4: Git, Maven and CI

4.1 Branching and Merging in Git, Git workflows, Git cheat sheet,
4.2 Introduction and requirement of CI, Introduction to Jenkins (With Architecture), Introduction to Maven

Unit5: CAMS (CULTURE, AUTOMATION, MEASUREMENT AND SHARING)

5.1 CAMS – Culture, CAMS – Automation, CAMS – Measurement, CAMS – Sharing,
5.2 Test-Driven Development, Configuration Management, Infrastructure Automation,
5.3 Root Cause Analysis, Blamelessness, Organizational Learning

Text Books/ Reference Books:

1. The DevOps Handbook - Book by Gene Kim, Jez Humble, Patrick Debois, and Willis Willis
2. What is DevOps? - by Mike Loukides
3. DevOps: A Software Architect's Perspective by Len Bass, Ingo Weber, Liming Zhu, 2018.
4. Practical DevOps by Joakim Verona, 2017, Packt publishing

https://www.coursera.org/learn/uva-darden-continous-delivery-devops
https://www.coursera.org/learn/devops-culture-and-mindset

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-707)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BCS-DS-707.1	2	1	2	-	1	-	-	-	-	-	2	1	-	-	-
BCS-DS-707.2	3	1	3	1	2	-	-	1	1	2	-	2	2	2	1
BCS-DS-707.3	1	3	3	2	-	1	-	2	2	1	2	1	-	2	2
BCS-DS-707.4	3	2	2	2	3	2	-	2	2	2	-	-	3	2	2
BCS-DS-707.5	2	-	2	3	2	2	-	-	1	2	-	-	2	-	3

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BCS-DS-754 : DEVOPS LAB

Periods/week	Credits	Max. Marks	: 100
P :2	1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Sem Examination	: 50

Course Type: Program Core
Prerequisite:Concept of DevOps with related technologies which are used to Code, Build, Test, m Configure & Monitor the Software Applications.
Course Outcomes: The students will be able to-
BCS-DS-754.1 Remember the importance of DevOps tools used in software development life cycle
BCS-DS-754.2 Understand the importance of Jenkins to Build, Deploy and Test Software Applications
BCS-DS-754.3 Examine the different Version Control strategies
BCS-DS-754.4 Analyze & Illustrate the Containerization of OS images and deployment of applications over Docker
BCS-DS-754.5 Summarize the importance of Software Configuration Management in DevOps and Synthesize the provisioning using Chef/Puppet/Ansible or Saltstack.
List of Practicals:
1. Installation of Git Devops tool, Branching and Merging in Git
2. To Install and Configure Docker for creating Containers of different Operating System Images.
3. Commands n Git, Git workflows, Git cheat sheet.
4. To Install and Configure Jenkins to test, and deploy Java or Web Applications using Netbeans or eclipse.
5. To Perform Version Control on websites/Software using different Version control tools like RCS/ CVS/GIT/Mercurial (Any two).
6. To Install and Configure Docker for creating Containers of different Operating System Images.
7. To Build, deploy and manage web or Java application on Docker.
8. To install and configure Software Configuration Management using Chef/Puppet/Ansible or Saltstack.

Text Books / Reference Books:
1. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
2. Len Bass,Ingo Weber,Liming Zhu,"DevOps, A Software Architects Perspective", AddisonWesley-Pearson Publication.
3. Learn to Master DevOps by Star EduSolutions

Software required/Weblinks:
https://www.jenkins.io/download/
https://docs.docker.com/docker-for-windows/install/
rcises to be given by the teacher concerned.

Note: At least 5 more exe https://git-scm.com/downloads

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-754)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-754.1	2	-	1	-	1	-	-	-	2	2	-	-	2	2	-
BCS-DS-754.2	3	-	2	2	2	1	-	-	1	2	2	-	2	2	2
BCS-DS-754.3	2	-	3	1	1	-	-	-	1	1	-	-	2	3	3
BCS-DS-754.4	3	1	3	1	2	-	-	-	1	-	-	2	2	2	2
BCS-DS-754.5	2	2	3	2	3	-	-	-	2	3	2	2	3	3	3

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BCS-DS-701: SECURITY IN CLOUD (CC)

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Cloud Computing Architecture and Deployment Models (BCS-DS-527)
Course Type: Program Core

Course Outcomes: Students will be able to-

BCS-DS-701.1 Analyze the Cloud computing setup with it's vulnerabilities and applications using different architectures.
BCS-DS-701.2 Design different workflows according to requirements and apply map reduce programming model.
BCS-DS-701.3 Apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.
BCS-DS-701.4 Create combinatorial auctions for cloud resources and design scheduling algorithms for computing clouds
BCS-DS-701.5 Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application
BCS-DS-701.6 Broadly educate to know the impact of engineering on legal and societal issues involved in addressing the security issues of cloud computing

PART- A

Unit-1: Security Overview

1.1. Security Overview-Operating System – Security, Authentication, One Time passwords, Program Threats, System Threats
1.2 Computer Security Classifications, Application Security, Application Code Review, Secure Developer Training, Data Center Security,
1.3 Security – Cloud Computing, Security Framework, Architecture Principles, System Management Components.

Unit-2: Understanding Security Risks

2.1 Understanding Security Risks, Understanding security risks, Identifying the biggest risks,
2.2 Cloud computing - Working definition , Top security benefits, Top security risks, Security benefits of cloud computing, Security and the benefits of scale,
2.3 Risks, Virtualization, Overview, Hypervisor, I/O Virtualization, Partitioning,
2.4 Server Deployment, Virtual Server Deployment , What is a Tenant?, Defining Multi-Tenancy, Securing the Multi-Tenant Environment,
2.5 Vulnerability: An Overview, Defining Vulnerability, Vulnerabilities and Cloud Risk, Cloud Computing, Core Cloud Computing Technologies ,
2.6 Essential Characteristics, Cloud-Specific Vulnerabilities, Core-Technology Vulnerabilities, Essential Cloud Characteristic Vulnerabilities,
2.7 Defects in Known Security Controls, Prevalent Vulnerabilities in State-of-the-Art Cloud Offerings, Architectural Components and Vulnerabilities, Internal Security Breaches,
2.8 Cloud Software Infrastructure and Environment, Computational Resources, Storage, Communication, Cloud Web Applications, Services and APIs, Management Access, Identity, Authentication, Authorization, and Auditing Mechanisms, Provider, Data Corruption, User account and Server Hijacking, How to Secure Your Cloud..

Unit-3: Addressing security risks in cloud

3.1 Introduction,
3.2 Core Components of AAA, Example AAA Flow,
3.3 Authorization Approaches, Accounting Techniques

PART-B

Unit-4: Identity Management

4.1 Identity management, Isolated identity management, Federated identity management, Centralized identity management,
4.2 Authentication and Authorization, Challenges of Identity Management, Identity Theft, Identity Management Adoption and Benefits, Benefits of Identity Management,
4.3 Conclusion, Evolution of IAM — moving beyond compliance,
4.4 Identity access Management life cycle phases, IAM and IT trends,
4.5 Mobile computing, Cloud computing, Data loss prevention,
4.6 Social media, IAM and cybercrime,
4.7 Case study — IAM in practice, Transforming IAM,
4.8 Life cycle phase, Key considerations when transforming IAM, People, Process Technology, IAM tools,
4.9 Key IAM capabilities, Conclusion, Detention, Field Acquisition & Analysis, Solid State Drives,
4.10 Brief Discussion of Cylinders, Heads, and Sectors , Logical Block Addressing and Physical Block Addressing, "TRIM" Command.

Unit-5: Encryption and Decryption

5.1 Encryption and decryption, What is cryptography?, Strong cryptography
5.2 How does cryptography work?, Conventional cryptography, Caesar's Cipher, Key management and conventional encryption,
5.3 Public key cryptography, How PGP works, Keys, Digital signatures, Hash functions,
5.4 Digital certificates, Certificate distribution, Certificate servers,
5.5 Public Key Infrastructures, Certificate formats, Validity and trust,
5.6 Checking validity, Establishing trust, Meta and trusted introducers, Trust models,
5.7 Levels of trust in PGP , Certificate Revocation,
5.8 Communicating that a certificate has been revoked ,
5.9 What is a passphrase?, Key Splitting, Encryption,
5.10 Data Encryption - Overview , Symmetric Encryption and Asymmetric encryption, Conclusions. Digital signature,
5.11 Secure Sockets Layer (SSL), Encryption Protects Data During Transmission

Unit-6: Advance security Essentials

6.1 Credentials Establish Identity Online, Authentication Generates Trust in Credentials,
6.2 Extend Protection beyond HTTPS, Understanding SSL, Who Uses SSL?, How It Works, SSL Transactions ,
6.3 SSL Crypto Algorithms, SSL and the OSI Model, Secure messaging, Message digest,
6.4 Security Technology, Identity, Integrity, Active Audit, Cryptography,
6.5 Public key infrastructure, Non-repudiation, Public Key Encryption,
6.6 Introduction to Authentication, Background,
6.7 SSL authentication (server --> client), Mutual SSL Authentication (server <--> client), Capture and Analyze.

Text Books/ Reference Books:

1. Security in Cloud, IBM ICE Publication.
2. Paul Goransson and Chuck Black, 2014, Software Defined Networks: A Comprehensive Approach, 1st edition, Morgan Kaufmann Publishers, Inc., San Francisco. ISBN-13: 978-0124166752, ISBN-10: 012416675X
3. T. Erl, R. Puttini, and Z. Mahmood, 2013, Cloud Computing: Concepts, Technology & Architecture • ISBN-10: 0133387526 • ISBN-13: 9780133387520 • Prentice Hall • Cloth, 528 pp
4. Rajkumar Buyya, James Broberg, Andrzej Goscinski, 2014, Cloud Computing Principles and Paradigms, Willey
5. Kai Hwang, Jack Dongarra and Geoffrey Fox, Morgan Kaufmann, 2011, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things.
6. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, 2010, Cloud Computing: A Practical Approach, McGraw Fill.

Software required/Weblinks:

www.ibm.com
www.amazon.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-701)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-701.1	3	3	2	3	1	-	-	-	-	2	1	-	-	1	1
BCS-DS-701.2	3	3	3	1	1	2	1	1	2	2	2	1	2	1	1
BCS-DS-701.3	3	3	3	1	1	1	1	1	1	1	2	1	1	1	2
BCS-DS-701.4	3	3	3	1	3	1	2	1	1	1	1	2	1	-	-
BCS-DS-701.5	3	3	1	1	3	-	1	-	-	-	1	1	1	-	-
BCS-DS-701.6	3	3	-	2	1	3	2	-	1	3	2	1	-	-	-

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BCS-DS-731: INTRODUCTION TO IoT (CC)

Periods/week	Credits	Max. Marks	: 200
L :2 T: 0	2.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Programming : Python, Javascript, C/C++, Basic knowledge of any of Azure, concepts of networking
Course Type: Program Electives

Course Outcomes: Students will be able to-

BCS-DS-731.1 Describe concepts and technologies of IoT communication.
BCS-DS-731.2 Define the processes for IoT solutions and data management in IoT.
BCS-DS-731.3 Identify different infrastructure components including sensors, embedded hardware, gateways and network systems for IoT applications.
BCS-DS-731.4 Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack.
BCS-DS-731.5 Illustrate security requirements and privacy risks in IoT communication.
BCS-DS-731.6 Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.

PART- A

Unit-1: Introduction
1.1 IOT Concepts
1.2 Introduction to IOT Communications
1.3 Telemetry vs IOT
1.4 Applications of IOT Communications
1.5 People, Processes and Devices.

Unit-2: IOT Technologies behind smart and intelligent devices
2.1 Automation, asset management
2.2 Telemetry, transportation, telematics.
2.3 Telemetry and Telemetric; Report location, logistics
2.4 Tracking and remote assistance; next generation kiosks
2.5 Self-service technology; Cellular IOT connectivity services

Unit-3: IOT Applications
3.1 IOT Verticals
3.2 IOT Hosted Services
3.3 IOT Application development.
3.4 IOT Connectivity
3.5 IOT Software providers.

PART-B

Unit-4: IOT Systems and Networks
4.1 Study of RF Wireless Sensors
4.2 Wireless networks and Wireless Sensor Networks
4.3 Computer Connected to Internet
4.4 Network Devices
4.5 Device configuration and management
4.6 Exchange information in real time without human intervention.

Unit-5: IOT Design and System Engineering
5.1 IOT Requirements; Hardware & Software
5.2 Study of IOT Sensors
5.3 Tagging and Tracking

5.4 Embedded Products
5.5 IOT Design; (U) SIM Card Technology
5.6 IOT Connectivity and Management
5.7 IOT Security & IOT Communication.

Unit-6: IOT Communication Technologies & Security
6.1 Cellular Machine-to- Machine (M2M) application networks
6.2 Software for M2M Applications, Hardware
6.3 IP Based Cellular Networks & 3G, 4G.
6.4 Security & Trust M2M Communications; Secure Communications
6.5 M2M Security Framework
6.6 Securing Data input/output and internet communication.

Text Books / Reference Books:
Introduction to IOT, IBM ICE Publication.

Software required/Weblinks:
https://onlinecourses.nptel.ac.in/noc17_cs22
www.analyticsvidya.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-731)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-731.1	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
BCS-DS-731.2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
BCS-DS-731.3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
BCS-DS-731.4	-	-	2	3	2	-	-	-	-	-	-	-	-	-	-
BCS-DS-731.5	-	-	-	-	-	2	3	1	-	-	-	-	-	-	-
BCS-DS-731.6	-	-	-	2	2	3	-	-	-	1	-	2	1	-	-

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BCS-DS-773: INTRODUCTION TO IoT LAB (CC)

Periods/week	Credits	Max. Marks	: 100
P: 2	1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Introduction To IoT (BCS-DS-731)
Course Type: Program Electives

Course Outcomes: Students will be able TO-

BCS-DS-773.1. Identify different infrastructure components including sensors, embedded hardware, gateways and network systems for specified IoT application.
BCS-DS-773.2. Set up an embedded/microcomputer system and enable to write IoT application on it.
BCS-DS-773.3. Integrate microcontroller/microcomputer system with sensors to acquire data in real time.
BCS-DS-773.4. Establish a secure and consistent communication from microcontroller/microcomputer system to the cloud.
BCS-DS-773.5. Design an application to create communication with multiple sensors to store data locally and make it available on the Internet for subsequent comparison with cloud data.
BCS-DS-773.6. Apply the knowledge and skills acquired during the course to design IoT based solutions for real world problems.

List of Experiments:
1. Write a program to assign NET10 module an IPv4 address and perform a ping operation to the PC.
2. Design an application to store/update the sensed value to a HTTP webpage using the iSense IP stack and API'S
3. Implement Constraint Application Protocol (CoAP) to access the sensor value at the application layer.
4. Design a web page with default IP address such that it should display the values sent by the sensor with NET 10 interface.

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-773)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-773.1	1	3	-	-	-	-	-	-	-	-	-	1	-	-	1
BCS-DS-773.2	-	-	3	1	-	2	-	-	-	-	-	1	-	-	-
BCS-DS-773.3	-	-	2	2	-	-	-	-	-	-	-	1	-	-	-
BCS-DS-773.4	-	-	-	-	3	2	2	-	-	-	-	1	-	-	-
BCS-DS-773.5	-	-	-	2	3	3	2	-	-	-	-	1	1	-	-
BCS-DS-773.6	-	-	-	-	2	2	3	-	1	-	2	1	-	2	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-730: BIG DATA ANALYTICS (CC, BA)

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Database Management System (BCS-DS-404)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-730.1. Explain and identify Big Data Fundamentals and its Business Implications.
BCS-DS-730.2. Apply the architectures and platforms introduced for Big data, in particular Hadoop and MapReduce.
BCS-DS-730.3. Access and process Data on Distributed File System.
BCS-DS-730.4. Develop Big Data Solutions using Hadoop Eco System.
BCS-DS-730.5. Understand Big Data Visualization Techniques.
BCS-DS-730.6. Understand and appreciate Analytics for Big data at Rest and in Motion.

PART A

Unit-1:Big Data Concepts
1.1 What is Big Data, Volume, Velocity, Variety,
1.2 Why it's Important, Risks of Big Data, Need of Big Data,
1.3 Structure of Big Data,Exploring Big Data,
1.4 Filtering Big Data, the Need for Standards,
1.5 Big Data and Analytics, Adoption Architecture, Benefits & Barriers,
1.6 Trends for Big Data Analytics

Unit-2:Hadoop Fundamentals
2.1 Hadoop Architecture, Hadoop File System (HDFS),
2.2 HDFS Administration , Map / Reduce concepts,
2.3 Setup of a Hadoop Cluster,
2.4 Managing Job Execution,
2.5 Move data into Hadoop using Flume, Data Loading,
2.6 Overview of workflow engine,

Unit-3:Query languages for Hadoop Eco System
3.1 Jaql Basics,
3.2 Jaql data types,
3.3 Input/output with Jaql,
3.4 Working with operators and expressions,
3.5 Use of Pig
3.6 Use of Hive

PART B

Unit-4:Hadoop Reporting and Analysis
4.1 Approaches to Big Data reporting and analysis,
4.2 Big Data Access Technologies for Reporting and Analysis,
4.3 Business Intelligence and Hadoop Architecture,
4.4 Direct Batch Reporting on Hadoop,
4.5 Live Exploration of Big Data,
4.6 Indirect Batch Analysis on Hadoop

Unit-5:Analytics for Big Data at Rest & in Motion-I
5.1 Data Stream overview,
5.2 Streams Processing Language Basics,
5.3 Streams Processing Language Development,
5.4 SPL Programming Introduction,

5.5 Adapter Operators,
5.6 Relational and Utility Operators

Unit-6:Analytics for Big Data at Rest & in Motion-II
6.1 Windowing and Joins,
6.2 Punctuation, aggregation and Sorting,
6.3 Timing and Coordination,
6.4 Lists, Sets, and Maps,
6.5 Nodes and Partitions, Debugging,
6.6 Adapters and Toolkits

Text Books / Reference Books:

1. None specified, 2016, Big Data Analytics, I edition, IBM ICE Publication.
2. Seema Acharya, Subhasini Chellappan, 2015, Big Data Analytics, Wiley.
3. John M., 2015, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, I edition, EMC Education service.
4. Tom White, Hadoop: The Definitive Guide, Storage and Analysis at Internet Scale, 4th edition, O'Reilly Media.
5. 2016, Big data Black Book: DT Editorial Services, Dream tech Press.
6. Chris Eaton, Dirk, 2012, Understanding Big data, 1st edition, McGraw Hill.

Software required/Weblinks:
Ibm.com
www. searchbusinessanalytics.techtarget.com
www.mastersindatascience.org

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-730)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-730.1	3	2	2	-	3	-	-	-	-	-	-	-	1	2	-
BCS-DS-730.2	1	2	-	-	-	2	3	-	-	-	-	-	1	2	3
BCS-DS-730.3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	3
BCS-DS-730.4	1	2	3	-	-	-	-	-	-	-	-	-	1	-	2
BCS-DS-730.5	-	2	3	-	-	-	-	-	-	-	-	-	-	2	3
BCS-DS-730.6	1	2	3	-	-	-	-	-	-	-	2	3	1	2	3

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NAAC 'A' Grade University

BCS-DS-772: BIG DATA ANALYTICS LAB (CC, BA)

Periods/week Credits	Max. Marks	: 100
P: 2 1.0	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs	End Sem Examination	: 50

Co-Requisite: Big Data Analytics (BCS-DS-730)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-772.1: Understand the hadoop file systems.
BCS-DS-772.2: Import the data files, manipulate and transform the data.
BCS-DS-772.3: Use the market relevant tools, used in BDA.
BCS-DS-772.4: Apply various kinds of filters and extract the information.
BCS-DS-772.5: Use models to solve various problems of big data.
BCS-DS-772.6: Handle data in available in various formats.

List of Experiments:
1. Installation of IBM/Biginsight on VMWare and/or Cloudera on Virtual Box
2. Hadoop:Interaction with the hadoop file system using "hdfs dfs -put/mkdir/ls/put/get/cp/rm" etc.
3. Hadoop:Learnto work on Hbase Shell. Create the table, load, select etc.
4. Hbase: Apply different kind of filtersand sort operationsin the table created in Hbase shell.
5. Jaql:Create/downloada JSONFile, Read it in the Jaql, apply filter and transform. Write the output to a file.
6. Jaql:Create/downloadtwo JSON files, read both of them and perform join operations.
7. Pig:Load a log file into HDFS and perform work count operation on it using commands: Load, foreach, groupby, tokenize, flatten, generate and count.
8. Pig:Create two CSV files in PIG, load them into variables and perform filter and / or join operations.
9. Hive: Cretae / Downloada Database,Table and load data into it from a publically available dataset site, alternatively create your own file and load it.
10. Hive: Perform select operations using where, group by and orderby clause.
11. Hive: Create atleast 2different views on the already created table and perform select operations.

Text Books/ Reference Books/ Internet References:

1. Seema Acharya and Subhashini Chellapan, Big Data and Analytics by
2. https://www.cloudera.com/documentation.html
3. https://www.ibm.com/support/knowledgecenter/en/SSPT3X_4.2.0/com.ibm.swg.im.infosphere.biginsights.welcome.doc/doc/welcome.html

Software required/Weblinks:
VMWare, IBM BigInsights
VirtualBox, Cloudera

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-772)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-772.1	1	-	-	2	3	2	2	-	1	1	-	1	3	1	-
BCS-DS-772.2	1	3	3	3	3	3	2	-	1	1	-	1	3	1	-
BCS-DS-772.3	1	3	3	3	3	3	2	-	-	2	-	1	3	1	-
BCS-DS-772.4	1	3	3	3	3	3	2	-	-	2	-	1	3	1	-
BCS-DS-772.5	1	3	3	3	3	3	2	-	1	-	-	1	3	1	-
BCS-DS-772.6	1	3	3	3	3	3	2	-	1	-	-	1	3	1	-

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BCS-DS-721: SIMULATION and MODELLING

Periods/week Credits — Max. Marks : 200
L: 3 T: 0 3.0 — Continuous Evaluation : 100
Duration of Exam: 3 Hrs — End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-721.1. Describe the role of important elements of discrete event simulation and modeling paradigm.
BCS-DS-721.2. Demonstrate real world situations related to systems development decisions, originating from source requirements and goals.
BCS-DS-721.3. Interpret the model to resolve critical issues in a real world environment.
BCS-DS-721.4. Develop simulation software to construct system model solutions.
BCS-DS-721.5. Apply goal-driven system models solutions for particular problems.

PART- A

Unit-1: Introduction to Simulation
1.1 History of simulation, desirable software features, General purpose simulation package,
1.2 Simulation, Advantages, Disadvantages, Areas of application,
1.3 System environment, components of a system,
1.4 Simulation Examples: Simulation of Queuing systems,
1.5 Simulation of Inventory System, Other simulation examples.

Unit-2: General Principles
2.1. Concepts in discrete - event simulation, event scheduling/ Time advance algorithm,
2.2. simulation using event scheduling,
2.3. Random Numbers: Properties, Generations methods, Tests for Random number,
2.4. Frequency test, Runs test, Autocorrelation test.

Unit-3: Random Variate Generation

3.1. Inverse Transform Technique- Exponential,
3.2. Uniform, Weibull, Triangular distributions,
3.3. Direct transformation for Normal and log normal Distributions,
3.4. convolution methods- Erlang distribution, Acceptance Rejection Technique,
3.5. Optimisation Via Simulation: Meaning, difficulty,
3.6. Robust Heuristics, Random Search.

PART –B

Unit-4: Analysis of Simulation Data

4.1 Input Modelling: Data collection, Identification and distribution with data,
4.2 Parameter estimation, Goodness of fit tests,
4.3 Selection of input models without data, Multivariate and time series analysis,
4.4 Verification and Validation of Model – Model Building, Verification,
4.5 Calibration and Validation of Models.

Unit-5: Output Analysis

5.1. Types of Simulations with Respect to Output Analysis, Stochastic Nature of output data,
5.2. Measures of Performance and their estimation, Output analysis of terminating simulation,
5.3. Output analysis of steady state simulations,
5.4. Simulation Software: Selection of Simulation Software,
5.5. Simulation packages, Trend in Simulation Software.

Unit-6: Analog vs Digital System

6.1. Simulation of water reservoir system, simulation of a servo system,
6.2. simulation of an auto-pilot, descrete system simulation,
6.3. Fixed time step vs event to event model,generation of random numbers,
6.4. Test for randomness, Monte-carlo computation vs stochastic simulation.

Text Books / Reference Books:

1. Geoffrey Gordon, 1978, System Simulation, 2nd Edition, Prentice Hall publication.
2. A.V. Aho, J.E. Hopcroft and T.D. Ullman, 1978, Data Structures and Algorithms, Pearson.
3. Jerry Banks, John S Carson, II, Berry L Nelson, David M Nicol, 2009, Discrete Event system Simulation, 5th Edition,Pearson Education
4. Averill M Law, W David Kelton, 2000, Simulation Modelling & Analysis, 3rd Edition, McGraw Hill
5. Kamathne, 2004, Introduction to Data Structures in C , 1st Edition, Pearson Education
6. Narsingh Deo, 2004, Systems Simulation with Digital Computer, 3rd Edition, PHI Publication

Software required/Weblinks:

www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials

Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-721)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-721.1	1	-	-	-	2	-	-	-	-	-	-	3	-	-	-
BCS-DS-721.2	2	-	-	1	3	-	-	-	-	-	-	-	-	-	-
BCS-DS-721.3	-	-	-	-	-	-	-	-	-	1	-	1	3	2	1
BCS-DS-721.4	3	-	3	3	-	-	-	-	-	-	2	1	1	3	2
BCS-DS-721.5	3	-	-	3	-	-	-	-	-	-	-	3	-	2	-

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BCS-DS-771: SIMULATION and MODELLING LAB

Periods/week	Credits	Max. Marks	: 100
P:2	1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Sem Examination	: 50

Co-Requisite: Simulation and Modelling (BCS-DS-721)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-771.1. Apply Matlab for interactive computations.
BCS-DS-771.2. Analyze the results of problems.
BCS-DS-771.3. Perform simulation of different queuing systems.
BCS-DS-771.4. Implement various complex engineering problems using MATLAB and simulation tools.
BCS-DS-771.5. Construct various matrix operations and matrix relevant equations.

List of Practicals:
1 .Study the main windows in MATLAB desktop and perform the analysis.
2. Perform Computer Generation of Random Numbers using MATLAB.
3. Implement Chi-Square goodness –of-fit test using dummy values.
4. Perform the test for Standard Normal Distribution.
5. Implementation of Random Number Generators using MATLAB.
6. Perform Monte Carlo Simulation and analyse the results
7. Steps to perform Simulation of Single Server Queuing System.
8. Steps to perform simulation of Two Server Queuing System.
9. Perform two samples Kolmogorov- Smirnov test.
10. Demonstrating how a system is represented using Simulink.

Software Required/Weblinks
Matlab,Simulink
Error! Hyperlink reference not valid.https://www.mathworks.com/products/matlab.html
ctms.engin.umich.edu/CTMS/index.php?example=Introduction...SimulinkModeling

Note: At least 1 more exercise to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-771)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-771.1	2	2	3	-	2	-	-	-	-	-	-	-	2	-	2
BCS-DS-771.2	2	3	-	-	3	-	-	-	-	-	-	-	3	2	2
BCS-DS-771.3	2	2	3	-	3	-	-	-	-	-	-	-	3	-	2
BCS-DS-771.4	2	3	3	3	-	-	-	-	-	-	-	-	-	2	2
BCS-DS-771.5	2	3	-	3	3	-	-	-	-	-	-	-	1	-	2

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BCS-DS-734: Automation and Robotics

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Term Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Student will be able to-
BCS-DS-734.1. Acquire basic knowledge on Intelligent systems
BCS-DS-734.2. Describe semantic networks
BCS-DS-734.3. Demonstrate uncertainty of knowledge based systems
BCS-DS-734.4. Acquire basic knowledge on Robots
BCS-DS-734.5. Analyze robot transformations and sensors
BCS-DS-734.6. Design an Intelligent system

PART –A

Unit-1: Introduction
1.1 Introduction: Data, Information and Knowledge
1.2 Models of Knowledge Representations
1.3 Representation and reasoning in logic
1.4 Applications of artificial Intelligence

Unit-2: Semantic Networks
2.1 Semantic Representations: Semantic networks
2.2 Frames
2.3 Conceptual dependencies, conceptual graphs
2.4 Ontology: Basic introduction

Unit-3: Knowledge based sytems
3.1 Architecture of knowledge based system
3.2 Rule based programming and production system
3.3 Rule chaining and inference control
3.4 Reasoning about knowledge, Temporal Reasoning
3.5 Inference under Uncertainty: Bayesian techniques, Fuzzy reasoning

PART –B

Unit-4: Intelligent agents
4.1 Introduction: the agent metaphor and attributes of agent hood
4.2 Types of intelligent agents
4.3 Agent theory and languages

Unit-5: Introduction to Robotics
5.1 Robotics Anatomy: Definition, Law of Robotics
5.2 History and Terminology of Robotics- Accuracy and Repeatability of Robotics
5.3 Architecture of Robotic Systems
5.4 Robot Classifications

Unit-6: Robot Sensors and Controls
6.1 Robot Kinematics types – 2D 3D Transformations Scaling, Rotation, Translation
6.2 Sensors in Robot – Touch Sensors Tactile Sensors, Proximity and range Sensors, Light Sensors, Pressure Sensor
6.3 Robot Work Cell design – Sequence Control, Operating Interface, Mobile Robot Working Principle

Text Books / Reference Books:
1. Dr Michael Negnevitsky, Adison Wesley, Artificial Intelligence: A Guide to Intelligent Systems
2. Nilsson,2003, Intelligent Systems: A new Synthesis, Oxford publication

3. D K Pratihar, 2017 Fundamental of Robotics, Oxford publication

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-734)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-734.1	3	-	-	1	-	-	-	-	-	-	-	-	-	1	
BCS-DS-734.2	1	-	-	2	-	-	-	-	1	-	-	-	-	-	1
BCS-DS-734.3	1	-	-	-	-		-	-	-	-	-	-	-	-	-
BCS-DS-734.4	3	-	-	-	2	2	1	-	-	-	-	1	2	1	
BCS-DS-734.5	2	3	1	1	3	2	1	-	-	2	-	1	2	2	1
BCS-DS-734.6	-	-	3	3	1	-	-	-	3	2	2		1	3	3

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BCS-DS-723: Parallel and Distributed Algorithms

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-723.1. Define the concepts of parallelism, parallel architecture and applications of parallel and distributed computing
BCS-DS-723.2. Understand the various principles for parallel algorithm designing
BCS-DS-723.3. Apply the concepts of parallelism for real life problems of tree traversal and matrix operations
BCS-DS-723.4. Designing of sorting algorithms and graph related problems using concepts of parallelism
BCS-DS-723.5. Analyze the performance of numerous parallel computing algorithms using performance model and matrices
BCS-DS-723.6. Demonstrate the components of different distributed systems models

PART –A

Unit-1: Introduction: parallelism
1.1 The idea of parallelism, reasons of using parallelism
1.2 Parallel Computers for increase Computation speed, different parallel architecture,
1.3 Forms of Parallelism, Parallel & Cluster Computing
1.4 Reasoning about performance of parallel programs.
1.5 Applications and challenges of Parallel and Distributed Computing

Unit-2: Principles of Parallel Algorithm Design
2.1 Decomposition Techniques
2.2 Message Passing Technique- Evaluating Parallel programs and debugging
2.3 Pointer Jumping: Useful Techniques for Parallelization

Unit-3: Parallel Algorithms & programming
3.1 Parallel Programming Language, Brent’s Theorem
3.2 PRAM Algorithms: Parallel Reduction, Prefix Sums, List Ranking, Preorder Tree Traversal, Merging Two Sorted Lists,
3.3 Parallel algorithms on network, Matrix-Vector Multiplication, Matrix-Matrix Multiplication

PART –B

Unit-4: Sorting & Graph Algorithms
4.1 Sorting: Bubble Sort and Variants, Quick Sort, Other Sorting Algorithms
4.2 Graph Coloring, Minimum Spanning Tree: Prim's Algorithm
4.3 Single-Source Shortest Paths: Dijkstra's Algorithm
4.4 All-Pairs Shortest Paths

Unit-5: Performance Models, Metrics and Techniques
5.1 Computational Model - Complexity - Work vs. Cost, Number of operations
5.2 Cost-optimality, Number of processors, Brent's Theorem Examples.
5.3 Parallel Computing and Performance - Speedup: Amdahl’s Law, Multi Core as a special case
5.4 Parallel Computing and Performance - Multi-Threading and Latency Hiding; Non-linear Speedup; Scaled Speedup (Gustafson’s Law) and Iso-efficiency.

Unit-6: Distributed System Models

6.1 Distributed system models

6.2 Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives

6.3 Distributed synchronization, Consistency

6.4 Distributed storage, Wide area computing, distributed hash table

Text Books/ Reference Books:

1. A Grama, A Gupra, G Karypis, V Kumar.2003, Introduction to Parallel Computing, 2nd ed.,Addison Wesley.
2. Barry Wilkinson and Michael Allen. 2005 Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers, 2nd Edition, Prentice Hall PTR, ISBN 0-13-140563-2
3. H. El-Rewini and T.G. Lewis. 1997 Distributed and Parallel Computing, Manning ISBN 0-13-795592-8.
4. Barry Wilkinson, Michael Allen Parallel Programming, Pearson Education, 2nd Edition.
5. Jaja, 1992, Introduction to Parallel algorithms, Pearson.

Software required/Weblinks:

http://wla.berkeley.edu/~cs61a/fa11/lectures/communication.html
https://lecturenotes.in/subject/96/parallel-and-distributed-systems-pds
https://cs.stackexchange.com/questions/51099/parallel-vs-distributed-algorithms

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

Course Articulation Matrix:

CO Statement (BCS-DS-723)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-723.1	3	2	1	2	1	2	2	2	2	2	2	2	1	2	2
BCS-DS-723.2	3	3	3	3	2	3	1	3	2	2	1	2	2	2	2
BCS-DS-723.3	3	3	3	3	3	2	1	2	2	2	1	2	2	2	2
BCS-DS-723.4	3	3	3	3	3	2	1	2	2	3	1	2	2	3	2
BCS-DS-723.5	3	3	2	3	3	2	2	1	2	3	1	2	2	3	2
BCS-DS-723.6	3	3	2	1	2	2	2	2	2	2	2	2	2	2	2

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BCS-DS-724: Advanced Computer Networks

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Computer Networks (BCS-DS-405)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-724.1. Understand the basic concept of basic layers i.e Physical & Data link layers including its protocols & devices
BCS-DS-724.2. Describe various addressing Concepts & formation of IP & its types
BCS-DS-724.3. Introduce IP with its various generation & its format
BCS-DS-724.4. Learn transport layer protocols with its description.
BCS-DS-724.5. Analyse application layer protocols.
BCS-DS-724.6. Explore the concept of unicast & multicast routing protocols

PART -A

Unit-1: Physical & Data Link layer Protocols
1.1 Interfaces, Accessing the Network
1.2 Copper access technologies, Cable Access Technologies, Fiber Access Technologies, Air Access Technologies
1.3 LLC and MAC sub layer protocol, ATM (frame Format)
1.4 Ethernet, Token Ring, Token Bus and FDDI, Bridge protocols,
1.5 SONET/SDH standards, Dense wavelength division multiplexing (DWDM)

Unit-2: Network Layer & its Protocols
2.1 IP Addressing: Address Space, Notations, Classful Addressing , Classless addressing , Network Address Translation
2.2 IP: Format , Fragmentation & Options
2.3 ICMPV4: Messages, Debugging Tools, ICMP Checksum
2.4 Mobile IP: Addressing , Agents, three Phases, Inefficiency in Mobile IP
2.5 Virtual Private Network

Unit-3: Next Generation IP
3.1 IPV6 Addressing: Representation, address space, address space allocation , Auto Configuration, Renumbering
3.2 Transition from IPV4 to IPV6 : Dual stack ,Tunneling, Header Translation
3.3 IPV6 Protocol: Packet Format , Extension Header

PART-B

Unit-4: Transport Layer & its Protocols
4.1 User Datagram Protocol (UDP): Datagram, Services &Applications
4.2 Transmission Control Protocol (TCP) : Features, Services , Segment
4.3 A TCP connection ,State Transition Diagram
4.4 TCP :Error Control, Flow Control. Congestion Control , Timers
4.5 SCTP : Services, Features, Packet Format, Error Control. Flow Control

Unit-5: Application Layer & its Protocols
5.1 World Wide Web , HTTP, FTP, TFTP
5.2 Electronic Mail : SMTP,POP, MIME, IMAP, SNMP
5.3 DHCP: Static & Dynamic Allocation & DHCP Operation
5.4 Remote Login : TELNET & SSH

Unit-6: Unicast & Multicast Routing Protocols

6.1 Introduction: Inter –domain, Intra-domain Routing

6.2 Routing Algorithms: Distance Vector Routing , Bellman-Ford Algorithm, Link State Routing , Path Vector Routing

6.3 Unicast Routing Protocols: Introduction ,Internet structure, Routing information Protocol (RIP) Open shortest Path first (OSPF)

6.4 Multicast Routing Protocol: Introduction, Multicast Distance Vector (DVMRP), Multicast Link State (MOSPF)

Text Books/ Reference Books:

1. Behrouz A. Forouzan, Data Communication and Networking, 4th Edition, McGrawHil
2. B. M. Harwani Advanced Computer Network, DT Editorial Services , DreamTech , New Delhi
3. A. S. Tanenbaum, Computer Networks, 4th Ed., Pearson Education.
4. William Stallings, Data and Computer Communication, 8th Edition, Pearson Prentice Hall India.
5. L. Peterson and B. Davie, "Computer Networks – A Systems Approach" 5th Edition, Elsevier Morgan Kaufmann Publisher.
6. Comer Douglas. E, Internetworking with TCP/IP, Volume-I, Fourth Edition, Prentice Hall of India Ltd

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-724)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BCS-DS-724.1	2	2	1	2	3	2	2	1	-	1	1	2	2	3	1
BCS-DS-724.2	3	1	2	2	2	2	-	1	1	-	1	3	2	2	1
BCS-DS-724.3	2	3	2	1	2	2	1	1	1	1	1	2	2	1	2
BCS-DS-724.4	3	2	2	2	2	1	1	-	-	-	1	2	3	2	2
BCS-DS-724.5	1	1	1	3	1	2	2	1	1	-	1	3	2	1	2
BCS-DS-724.6	2	1	3	2	2	2	1	2	1	1	1	3	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-725: Network Security & Management

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-

BSC-DS-725.1. Learn security concepts and ethics in Network Security.
BSC-DS-725.2. Understand security standards of symmetric and asymmetric cryptography
BSC-DS-725.3. Recognize about the security threats and viruses.
BSC-DS-725.4. Identify the concept of Digital Signatures, authentication services and mechanisms
BSC-DS-725.5. Get familiar with existing protocols for email as well for web security.
BSC-DS-725.6. Understand about concepts of network management and various associated protocols.

PART –A

Unit-1: Introduction

1.1 OSI Security Architecture
1.2 Network security Models
1.3 Classical Encryption Techniques: Symmetric cipher model
1.4 Substitution Techniques
1.5 Transposition techniques, Rotor Machines.

Unit-2: Block Ciphers and Public Key Cryptography

2.1 Block Cipher Principles and its Modes of Operation
2.2 Data Encryption Standard, DES Encryption and Description.
2.3 Variants of DES: Double DES and Triple DES.
2.4 Principles of Public Key Cryptosystems
2.5 RSA Algorithm
2.6 Public Key Cryptosystems-Key Management
2.7 Diffie Hellman-key-Exchange.

Unit-3: System Security

3.1 Intruders, Intrusion Detection
3.2 Password Management
3.3 Malicious Software: Viruses and related Threats, Virus Countermeasures.
3.4 Firewalls: Design principles and Trusted Systems.

PART –B

Unit-4: Authentication and Digital Signatures

4.1 Authentication, Authentication requirements and functions
4.2 Hash functions, MD5 Message digest Algorithm
4.3 Secure Hash Algorithm(SHA)
4.4 Digital Signatures.

Unit-5: Network Security

5.1 Electronics Mail Security: PGP (Pretty Good Privacy), MIME, Data Compression techniques.
5.2 IP Security: Architecture, Authentication Header, Encapsulating security Payload, Key Management.
5.3 Web security: Secure Socket Layer & Transport Layer security
5.4 Secure electronic transactions.

Unit-6: Network Management

6.1. Network Management Model,
6.2. Infrastructure for Network Management,
6.3. SNMP v1, SNMP2 & SNMP3
6.4. Security Management, Security Analysis,
6.5. Change Management, Protecting Storage Area,
6.6. Risk Management, Identifying the risk to an Organization.

Text Books/ Reference Books:

1. William Stalling, Cryptography and Network Security Principal & Practices, PHI
2. Subramanian, Mani, Network Management Principles & Practices: AWL.
3. William Stalling, Simple Network Management Protocols: A Guide to Network Management: TMH.
4. Wang H.H., Telecom Network Management: TMH.
5. U. Black, Network Management: TMH.

Software Required/Weblinks:

https://onlinecourses.nptel.ac.in/explorer/search?category=COMP_SCI_ENGG

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures / Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-725)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-725.1	3	-	-	-	-	-	-	-	-	-	-	2	1	2	2
BCS-DS-725.2	2	-	2	-	-	-	-	-	-	-	-	2	1	2	2
BCS-DS-725.3	2	-	-	3	-	2	-	1	-	1	-	3	-	2	2
BCS-DS-725.4	3	-	2	2	-	-	-	-	-	-	-	2	1	2	2
BCS-DS-725.5	2	-	-	-	-	-	-	-	-	-	-	2	-	2	2
BCS-DS-725.6	2	1	2	2	-	-	-	-	-	-	2	1	1	-	-

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BCS-DS-726: Distributed Operating System

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Operating Systems (BCS-DS-403)
Course Type: Program Electives

Course Outcomes: Students will be able to-

BCS-DS-726.1. Distinguish between operating systems and communication in distributed system.
BCS-DS-726.2. Apply different mutual exclusion algorithm on the basis of the problem and the concept of deadlock condition in the system .
BCS-DS-726.3. Create threads and process using various commands.
BCS-DS-726.4. Demonstrate the file management scenario in distributed file system and the various trends in distributed file system.
BCS-DS-726.5. Interpret the concept of memory management in distributed system, various consistency model and issue related to the shared memory system.
BCS-DS-726.6. Examine the process communication and memory management process in MACH operating system.

PART –A

Unit-1: Distributed Operating System Concepts

1.1. Introduction to Distributed System, Goals of Distributed system
1.2. Hardware and Software concepts, Design issues
1.3. Communication in distributed system: Layered protocols, ATM networks, Client–Server mode
1.4. Remote Procedure Calls and Group Communication. Middleware and Distributed Operating Systems.

Unit-2: Synchronization in Distributed System

2.1. Clock synchronization, Mutual Exclusion
2.2. Election algorithm, the Bully algorithm, a Ring algorithm, Atomic Transactions
2.3. Deadlock in Distributed Systems, Distributed Deadlock Prevention, Distributed Deadlock
2.4. Detection

Unit-3: Processes and Processors in Distributed Systems

3.1. Threads, System models
3.2. Processors Allocation, Scheduling in Distributed System
3.3. Real Time Distributed Systems.

PART -B

Unit-4: Distributed File Systems

4.1. Distributed file system Design
4.2. Distributed file system Implementation
4.3. Trends in Distributed file systems.

Unit 5: Distributed Shared Memory

5.1. Concept of shared memory, Consistency models
5.2. Page based distributed shared memory
5.3. Shared variables distributed shared memory.

Unit-6: Case Study MACH

6.1. Introduction to MACH, process management in MACH, communication in MACH
6.2. UNIX emulation in MACH.

Text Books /Reference Books:

1. Andrew S. Tanenbaum, 2002, Distributed Operating Systems,1st edition, PHI.
2. Pradeep K. Sinha, 1998, Distributed Operating System, 1st edition,Wiley
3. O.S, M. Singhal & Shivratri, 2006, Advanced Concepts in Operating System Distributed Databases & Multiprocessor, 2nd edition, McGH

WebLinks:

http://nptel.ac.in/
https://www.tutorialspoint.com/
https://en.wikipedia.org/wiki/Distributed_operating_system
http://ieeexplore.ieee.org

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-726)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-726.1	1	-	-	-	3	-	-	-	-	1	-	-	-	3	3
BCS-DS-726.2	1	1	-	3	2	-	-	-	2	-	-	-	-	3	-
BCS-DS-726.3	-	-	2	3	-	-	-	-	-	-	-	3	-	-	2
BCS-DS-726.4	-	-	-	-	-	-	3	-	-	-	-	-	2	-	-
BCS-DS-726.5	-	-	2	3	-	-	-	-	2	-	-	-	3	-	-
BCS-DS-726.6	3	2	-	-	-	-	-	2	-	-	3	-	-	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BCS-DS-727: Data Science

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-727.1. Describe a flow process for data science problems.
BCS-DS-727.2. Classify data science problems into standard typology.
BCS-DS-727.3. Correlate results to the solution approach followed.
BCS-DS-727.4. Construct use cases to validate approach and identify modifications required.
BCS-DS-727.5. Develop R codes for data science solutions.
BCS-DS-727.6. Assess the solution approach.

PART –A

Unit-1. INTRODUCTION TO DATA SCIENCE:
1.7 Data science for engineers Course philosophy and expectation
1.8 Introduction to R
1.9 Variables and data types in R, Data frames
1.10 Recasting and joining of data frames
1.11 Arithmetic, Logical and Matrix operations in R
1.12 Control structures, Data visualization in R Basic graphics The study of language, applications of NLP

Unit-2. LINEAR ALGEBRA AND STATISTICAL MODELLING FOR DATA SCIENCE
2.1 Linear Algebra
2.2 Solving Linear Equation
2.3 Linear Algebra - Distance, Hyperplanes and Halfspaces, Eigen values, Eigen vectors
2.4 Statistical Modelling
2.5 Random Variables and Probability Mass/Density Functions
2.6 Sample Statistics
2.7 Hypotheses Testing

Unit-3. Optimization for Data Science
3.1 Basics of Optimization
3.2 Unconstrained Multivariate Optimization
3.3. Unconstrained Multivariate Optimization
3.4 Gradient (Steepest) Descent (OR) Learning Rule
3.5 Multivariate Optimization With Equality Constraints
3.6 Multivariate Optimization With Inequality Constraints

PART –B

Unit-4. PREDICTIVE MODELLING AND REGRESSION FOR DATA SCIENCE
4.1 Module : Predictive Modelling
4.2 Linear Regression
4.3 Model Assessment
4.4 Diagnostics to Improve Linear Model Fit
4.5 Simple Linear Regression Model Building
4.6 Simple Linear Regression Model Assessment
4.7 Simple Linear Regression Model Assessment (Continued)
4.8 Muliple Linear Regression

Unit-5. VALIDATION AND LOGIGITIC REGRESSION

5.1 Cross Validation
5.2 Multiple Linear Regression Modeling Building and Selection
5.3 Classification
5.4 Logisitic Regression
5.5 Performance Measures
5.6 Logisitic Regression Implementation in R

Unit-6. KNN and Recent trends in various data collection and analysis techniques
6.1 K - Nearest Neighbors (kNN)
6.2 K - Nearest Neighbors implementation in R
6.3 K - means Clustering
6.4 K - means implementation in R
6.5 Recent trends in various data collection
6.6 Analysis techniques
7.7 Various visualization techniques
7.8 Application development methods of used in data science.

Text Books/Reference Books:
1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional Tests
Surprise questions during lectures/Class Performance
End Sem Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-727)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-727.1	3	2	1	1	1	1	1	2	1	1	1	3	2	1	1
BCS-DS-727.2	1	3	1	1	3	1	1	1	1	1	1	2	1	1	1
BCS-DS-727.3	2	1	2	1	1	3	3	1	1	1	1	3	1	1	1
BCS-DS-727.4	1	2	2	3	1	2	2	1	1	2	1	2	2	1	2
BCS-DS-727.5	1	1	2	3	3	1	1	2	2	2	1	2	1	1	1
BCS-DS-727.6	1	1	3	1	2	1	1	2	3	1	2	2	2	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BCS-DS-728: Soft Computing

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-

BCS-DS-728.1. Define the basic concept of Intelligent Systems, Expert Systems, Knowledge Based systems and fuzzy logic.
BCS-DS-728.2. Describe the Semantic networks, Crisp logic, Fuzzy Systems and different types of Fuzzy hierarchical models, logical reasoning, Classical logic, Multi-valued logics, Fuzzy propositions, Fuzzy quantifier and Linguistic hedges.
BCS-DS-728.3. Judge the architecture of Fuzzy control, fuzzification and defuzzification.
BCS-DS-728.4. Apply the basic concepts of Artificial Neural Networks; Models of ANNs; Feed-forward & Feed-back networks, various learning rules and connectionist models.
BCS-DS-728.5. Examine the various genetic algorithms and its optimization.
BCS-DS-728.6. Integrate population based incremental learning.

PART -A

Unit-1: Overview of Soft Computing

1.1. Concept of Intelligent Systems,
1.2. Knowledge Based Systems and their architecture,
1.3. Production Systems,
1.4. Expert Systems.
1.5. Knowledge representation and processing,
1.6. Semantic networks.
1.7. Crisp logic, Fuzzy Systems, logical reasoning.
1.8. Soft Computing Paradigm: Fuzzy logic, Artificial Neural Networks, Genetic Algorithms.

Unit-2: Fundamentals of Fuzzy Logic

2.1. Overview of classical sets,
2.2. Fuzzy sets, fuzzy arithmetic,
2.3. fuzzy numbers, Fuzzy operations, fuzzy equations,
2.4. Extension principle, Fuzzy relations, fuzzy selection.

Unit-3: Fuzzy Logic

3.1. Fuzzy Propositions, fuzzy quantifiers,
3.2. linguistic hedges, composition and inference,
3.3. Inference laws, conditional fuzzy propositions,
3.4. Quantified propositions, fuzziness of fuzzy sets and fuzzy resolution,
3.5. Fuzzification and defuzzification.

PART -B

Unit-4: Fuzzy Systems

4.1. Fuzzy expert systems, fuzzy implication, approximate reasoning,
4.2. Basics of fuzzy controls,
4.3. Fuzzy Control Architecture: hierarchical fuzzy systems, hierarchical models,
4.4. Effect of information processing, decision table approach to fuzzy systems.
4.5. Introduction to Neuro-Fuzzy Systems,
4.6. Architecture of Neuro-Fuzzy Networks.

Unit-5: Artificial Neural Network

5.1. History, Mathematical Models of Neurons,
5.2. Artificial Neural Network (ANN) Architecture,

5.3. Activation functions,Learning Rules,
5.4. features of Neural Networks,
5.5. Supervised & Unsupervised Learning,
5.6. Reinforcement Learning.
5.7. ANN Training Algorithms, Perceptions,
5.8. Training Rules, Delta, Back-Propagation Algorithm,
5.9. Application of Artificial Neural Networks

Unit-6: Genetic Algorithms
6.1. Overview of evolutionary computing, evolutionary programming strategies and genetic programming,
6.2. Genetic algorithms, genetic algorithms and optimization,
6.3. Genetic Schema theorem, genetic algorithms operators,
6.4. Integration of genetic algorithms with fuzzy logic.
6.5. Population based incremental learning.
6.6. Applications of GA.

Text Books/ Reference Books:
1. Bart Kosko, 1997 , Neural Networks and Fuzzy Systems: illustrated edition, PHI.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutan, 1997, Neuro-fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, reprint edition, Prentice Hall.
3. Karray F.O. and Silva C.D., 2009, Soft Computing and Intelligent Systems, Pearson Education Edition, Pearson.
4. Klir, G.J. and Yuan, 2001, Fuzzy Sets and Fuzzy Logic: Theory and Applications, B. Illustrated edition, PHI.

Software required/Weblinks:
C/C++(TurboC/DOS BOX)
www. 3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-728)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-728.1	2	1	-	1	-	-	2	-	1	1	-	2	-	-	2
BCS-DS-728.2	2	-	1	-	1	1	-	-	-	-	-	1	1	-	2
BCS-DS-728.3	2	2	-	1	1	1	-	-	-	-	-	2	1	-	-
BCS-DS-728.4	3	3	2	2	1	2	-	-	-	2	1	-	2	1	2
BCS-DS-728.5	2	-	3	-	-	-	1	-	-	-	-	2	1	1	-
BCS-DS-728.6	1	-	-	-	1	1	-	-	-	-	-	-	-	-	1

SEMESTER – VIII

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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PROJ-CS-800: Internship –III

Periods/week	Credits	Max. Marks	: 300
24 weeks	10.0	Continuous Evaluation	: 200
Duration of Exam: 2 Hrs		End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Projects

Course Outcomes: Students will be able to-
PROJ-CS-800.1. Recognize the challenges of real working environment.
PROJ-CS-800.2. Apply their learning skills to solve real life problem.
PROJ-CS-800.3. Develop the synergetic collaboration between industry and the organization.
PROJ-CS-800.4. Enhance their Innovative skills.
PROJ-CS-800.5. Explore options in their career plans.
PROJ-CS-800.6. Integrate learning for catering to professional ethics and societal needs.

Every student will have to undergo Industrial Training for 10-12 weeks in the relevant field of Engineering in which he/she is enrolled for B.Tech programme after 6th semester. Respective Head of Department will approve the Industry/Organization for training. During this course of time he/she will be regularly monitored and evaluated. After successful completion of the training, the student will have to submit the training report, deliver a seminar about the work/project undertaken during the training and will have to appear for viva. The evaluation of the industrial training shall be made as per following:

Continuous Evaluation during training:

1. Evaluation by the Supervisor in the Industry	:	75 marks
2. Evaluation by Faculty Mentor during training visit	:	50 marks
3. Internal seminar/ Presentation	:	75 marks
Total Continuous Evaluation Marks	:	**200**

End Sem Evaluation after training:

1. Project Report	:	30 marks
2. Seminar/Presentation	:	20 marks
3. Viva	:	50 marks

Total End Sem Evaluation marks	:	**100**
Total Credits	**:**	**14**

The parameters for evaluation during the training for Supervisor shall be as under:

		Marks
Work/Project undertaken	:	15
Punctuality/Regularity	:	10
Discipline/Overall Conduct/Relations with seniors and others	:	10
Eagerness to acquire technical knowledge	:	20
Overall Proficiency achieved during training	:	10
Any contribution to the organization	:	10

Total		**75**

The parameters for evaluation by the faculty during training shall be as under:

Maintenance of Training Diary and Regularity	:	10
Relations with seniors and others	:	10
Overall Conduct	:	10
Willingness to Work	:	10
Proficiency achieved	:	10

		50

COURSE ARTICULATION MATRIX:

CO Statement (PROJ-CS-800)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
PROJ-CS-800.1	1	2	3	-	-	-	2	2	3	3	2	3	1	2	3
PROJ-CS-800.2	1	3	3	-	-	-	2	3	3	2	2	3	1	2	3
PROJ-CS-800.3	2	-	-	-	-	-	2	1	2	3	2	3	1	2	3
PROJ-CS-800.4	1	-	-	-	-	-	2	1	3	3	2	3	1	2	2
PROJ-CS-800.5	2	-	-	-	-	-	2	2	3	2	2	3	2	-	3
PROJ-CS-800.6	1	-	-	-	-	-	2	2	3	2	2	3	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

BCS-DS-822: Fuzzy Theory

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-822.1. Describe the basic concepts of Crisp & Fuzzy sets
BCS-DS-822.2. Implement the Operations on Fuzzy Sets.
BCS-DS-822.3. Apply the concept of Fuzzy numbers, Fuzzy Intervals and Fuzzy Equations.
BCS-DS-822.4. Relate different Fuzzy logics.
BCS-DS-822.5. Evaluate the concept of Fuzzy Logic to problems of different areas.
BCS-DS-822.6. Develop applications with help of Fuzzy Decision making.

PART- A

Unit-1: Fuzzy set theory
1.1 Crisp set theory
1.2 Concept of fuzzy set
1.3 certain crisp sets associated with Fuzzy set
1.4 Alpha cut and its properties
1.5 Representation of fuzzy sets
1.6 Extension principle for Fuzzy set
1.7 Triangular and trapezoidal fuzzy sets

Unit-2: Operations on Fuzzy sets
2.1 Types of operations (Complement, Union and Intersection)
2.2 Properties based on operations
2.3 Aggregation Operations and its properties

Unit-3: Fuzzy Arithmetic:
3.1 Fuzzy numbers
3.2 Fuzzy Intervals
3.3 Operations on Fuzzy numbers
3.4 Fuzzy Equations

PART- B

Unit-4: Fuzzy Relations
4.1 Introduction
4.2 Operations on Fuzzy Relations
4.3 Alpha-cuts of Fuzzy Relations
4.4 Composition of Fuzzy Relations
4.5 Projections of Fuzzy Relations
4.6 Cylindric extensions
4.7 Cylindric closure
4.8 Equivalence relations

Unit-5: Fuzzy Logic
5.1 Introduction
5.2 Multi-valued logics and infinite valued logics
5.3 Fuzzy logics
5.4 Fuzzy propositions and their interpretations in terms of fuzzy sets
5.5 Fuzzy inference
5.6 Fuzzification
5.7 Defuzzification

5.8 Generalizations of Fuzzy Logic

Unit-6: Fuzzy Decision Making
6.1 Role of aggregation operators in decision making
6.2 Individual decision making
6.3 Multi-person decision making
6.4 Multi-criteria decision making

Text Books / Reference Books:

1. Klir G.J. Yuan Bo, 2005, Fuzzy sets and Fuzzy Logic: Theory and Applications, First Edition, Prentice Hall of India Pvt. Ltd.
2. M. Ganesh, 2001, Introduction to Fuzzy Sets and Fuzzy Logic, PHI.
3. T.J.Ross, 1995, Fuzzy Logic with Engineering Applications, Second Edition, McGraw-Hill.

Software required/Weblinks:
www.maths.csusb.edu/notes/sets/sets.html
www.w3schools.com
www.tutorialspoint.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-822)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-822.1	2	3	-	1	-	-	-	-	-	-	-	-	2	-	2
BCS-DS-822.2	2	-	3	2	2	-	-	-	-	1	1	-	2	2	2
BCS-DS-822.3	2	3	3	3	2	-	-	-	2	1	-	-	2	3	2
BCS-DS-822.4	2	2	3	-	-	-	-	-	-	-	-	2	2	-	3
BCS-DS-822.5	3	-	-	2	2	-	-	-	-	-	-	-	-	2	2
BCS-DS-822.6	2	-	3	3	3	1	1	-	2	2	1	-	2	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-823: Computational Linguistics and Natural Language Processing

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-823.1. Describe the basic concept of Natural Language and different level of Language Analysis.
BCS-DS-823.2. Discuss the Morphological Analysis and The Lexicon.
BCS-DS-823.3. Interpret the behavior of different parsing algorithms with Languages.
BCS-DS-823.4. Understanding the grammar with help of Lexicon theory.
BCS-DS-823.5. Analysis of wordnet theory with help of languages.
BCS-DS-823.6. Develop system for Indian language.

PART- A

Unit-1. INTRODUCTION TO NATURAL LANGUAGE UNDERSTANDING:
1.1 The study of language, applications of NLP
1.2 Evaluating language understanding systems
1.3 Different levels of language analysis
1.4 Representations and understanding
1.5 Organization of natural language understanding systems
1.6 Llinguistic background: an outline of English syntax.

Unit-2. MORPHOLOGICAL ANALYSIS AND THE LEXICON
2.1 Morphology fundamentals
2.2 Morphological Diversity o f Indian Languages
2.3 Morphology Paradigms
2.4 Finite State Machine Based Morphology
2.5 Automatic Morphology Learning
2.6 Shallow Parsing; Named Entities

Unit-3. GRAMMARS AND PARSING:
3.1 Grammars and sentence structure
3.2 Theories of Parsing
3.3. Parsing Algorithms (Top-down and Bottom-up parsers)
3.4 Robust and Scalable Parsing on Noisy Text as in Web documents
3.5 Hybrid of Rule Based and Probabilistic Parsing
3.6 Probabilistic context-free grammars, best first parsing

PART- B

Unit-4. GRAMMARS AND MEANING FOR NATURAL LANGUAGE:
4.1 Auxiliary verbs and verb phrases
4.2 Movement phenomenon in language
4.3 Handling questions in context-free grammars
4.4 Lexical Knowledge Networks
4.5 Wordnet Theory
4.6 Indian Language Wordnets and Multilingual Dictionaries

Unit-5. HUMAN PREFERENCES IN PARSING
5.1 Encoding uncertainty
5.2 Deterministic parser
5.3 Word level morphology and computational phonology
5.4 Basic text to speech
5.5 Introduction to HMMs and speech recognition

5.6 Parsing with CFGs; probabilistic parsing

Unit-6. AMBIGUITY RESOLUTION
6.1 Statistical methods
6.2 Estimating probabilities
6.3 Part-of- speech tagging
6.4 Obtaining lexical probabilities
6.5 Scope Ambiguity and Attachment Ambiguity resolution.
6.6 Word senses and ambiguity, encoding ambiguity in logical form, Indian language case studies.

Text Books / Reference Books:

1 . Allen James, 2003, "Natural Language Understanding", 2nd edition, Pearson Education.
2. Ela Kumar "" Natural Language Processing ", I.K International Publication House.
3. Siddiqui Tanveer and Tiwary U. S., 2008, "Natural Language Processing and Information Retrieval", Oxford University Press.
4. Winograd Terry, 1983, "Language as a Cognitive Process", Addison Wesley.
5. Gazder G., 1989 "Natural Language Processing in Prolog", Addison Wesley.
6. Jurafsky D. and Martin J. H.,2002 "Speech and Language Processing", Pearson Education.
7. Manning Christopher D. and Schütze Hinrich, 1999 "Foundations of Statistical Natural Language Processing", The MIT Press, Cambridge, Massachusetts.
8. Dickinson, Brew, and Meuers 2013, Language and Computers.
9. Bender 2013 Linguistic Fundamentals for Natural Language Processing.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-823)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-823.1	3	2	1	1	1	1	1	2	1	1	1	3	2	1	1
BCS-DS-823.2	1	3	1	1	3	1	1	1	1	1	1	2	1	1	1
BCS-DS-823.3	2	1	2	1	1	3	3	1	1	1	1	3	1	1	1
BCS-DS-823.4	1	2	2	3	1	2	2	1	1	2	1	2	2	1	2
BCS-DS-823.5	1	1	2	3	3	1	1	2	2	2	1	2	1	1	1
BCS-DS-823.6	1	1	3	1	2	1	1	2	3	1	2	2	2	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-824: Cryptography and Network Security

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-824.1. Learn security requirement and basic principles.
BCS-DS-824.2. Compare and review existing cryptography algorithms.
BCS-DS-824.3. Apply security in our professional and in our day to day life
BCS-DS-824.4. Examine depth of security on different layers of network.
BCS-DS-824.5. Evaluate efforts to break security algorithms
BCS-DS-824.6. Develop new security algorithms as per application requirement.

PART- A

Unit-1: Introduction
1.1 Needs of security
1.2 Categories of security
1.3 OSI Security Architecture and other Network security Models
1.4 Classical Encryption Techniques
1.5 Symmetric cipher model
1.6 Substitution Techniques
1.7 Transposition techniques
1.8 Rotor Machines.

Unit-2: Block Ciphers and Encryption Standards
2.1 Block Cipher Principles and its Modes of Operation
2.2 Data Encryption Standard, DES Encryption and Description.
2.3 Variants of DES: Double DES and Triple DES
2.4 Advance Encryption Standard

Unit-3: Public Key Cryptography
3.1 Principles of Public Key Cryptosystems
3.2 RSA Algorithm
3.3 Public Key Cryptosystems-Key Management
3.4 Diffie Hellman-key-Exchange.

PART -B

Unit-4: Network Security
4.1 Authentication
4.2 Authentication requirements and functions
4.3 Hash functions
4.4 MD5 Message digest Algorithm
4.5 Secure Hash Algorithm(SHA)
4.6 Digital Signatures.
4.7 Electronics Mail Security: PGP (Pretty Good Privacy), MIME
4.8 Data Compression techniques.
4.9 IP Security: Architecture, Authentication Header, Encapsulating security Payload, Key Management.
4.10 Web security: Secure Socket Layer & Transport Layer security
4.11 Secure electronics transactions.

Unit-5: System Security
5.1 Intruders, Intrusion Detection
5.2 Password Management
5.3 Malicious Software: Viruses and related Threats, Virus Countermeasures

5.4 Firewalls: Design principles and Trusted Systems.

Unit-6: Network Management
6.1 Telecommunication Network Architecture
6.2 TMN management layers, Management information Model, Management servicing and functions
6.3 Structure of management information and TMN information model
6.4 Network Management Protocols: SNMP v1, SNMP2 & SNMP3, RMON1 & RMON2
6.5 Broadband Network Management: ATM, HFC, DSL, ASN.

Text Books / Reference Books:

1. William Stalling, Simple Network Management Protocols: A Guide to Network Management: TMH.
2. Subramanian, Mani, Network Management Principles & Practices : AWL
3. Wang H.H., Telecom Network Management: TMH.
4. U. Black, Network Management: U. Black, TMH.

Software required/Weblinks:
https://www.smartzworld.com/notes/cryptography-network-security-notes-pdf-cns-notes-pdf/
https://lecturenotes.in/subject/112/cryptography-and-network-security-cns
http://www.vssut.ac.in/lecture_notes/lecture1428550736.pdf

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-DS-824)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-824.1	3	2	1	1	1	1	1	2	1	1	1	3	2	1	1
BCS-DS-824.2	1	3	1	1	3	1	1	1	1	1	1	2	1	1	1
BCS-DS-824.3	2	1	2	1	1	3	3	1	1	1	1	3	1	1	1
BCS-DS-824.4	1	2	2	3	1	2	2	1	1	2	1	2	2	1	2
BCS-DS-824.5	1	1	2	3	3	1	1	2	2	2	1	2	1	1	1
BCS-DS-824.6	1	1	3	1	2	1	1	2	3	1	2	2	2	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-825: Machine Learning with Big Data

Periods/week Credits	Max. Marks	: 200
L :3 T: 0 3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs	End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-825.1. Design an approach to leverage data using the steps in the machine learning process.
BCS-DS-825.2. Apply machine learning techniques to explore and prepare data for modeling.
BCS-DS-825.3. Identify the type of machine learning problem in order to apply the appropriate set of techniques.
BCS-DS-825.4. Construct models that learn from data using widely available open source tools.
BCS-DS-825.5. Analyze big data problems using scalable machine learning algorithms.
BCS-DS-825.6. Evaluate the different models for different techniques.

PART- A

Unit-1: Introduction to Machine Learning with Big Data
1.1 Machine Learning Overview
1.2 Categories of Machine Learning Techniques
1.3 Goals and Activities in the Machine Learning Process
1.4 Scaling Up Machine Learning Algorithms
1.5 CRISP-DM

Unit-2: Data Exploration
2.1 Data Exploration
2.2 Data Exploration through Summary Statistics
2.3 Data Exploration through Plots
2.4 Exploring Data with KNIME Plots
2.5 Data Exploration in Spark

Unit-3: Data Preparation
3.1 Data Preparation
3.2 Data Quality
3.3 Addressing Data Quality Issues
3.4 Feature Selection
3.5 Feature Transformation
3.6 Dimensionality Reduction
3.7 Handling Missing Values in KNIME
3.8 Handling Missing Values in Spark

PART -B

Unit-4: Classification
4.1 Classification
4.2 Building and Applying a Classification Model
4.3 Classification Algorithms
4.4 k-Nearest Neighbors
4.5 Decision Trees
4.6 Naïve Bayes
4.7 Classification using Decision Tree in KNIME
4.8 Classification in Spark

Unit-5: Evaluation of Machine Learning Models
5.1 Generalization and Overfitting
5.2 Overfitting in Decision Trees

5.3 Using a Validation Set
5.4 Metrics to Evaluate Model Performance
5.5 Confusion Matrix
5.6 Evaluation of Decision Tree in KNIME
5.7 Evaluation of Decision Tree in Spark

Unit-6:Regression, Cluster Analysis, and Association Analysis
6.1. Regression Overview
6.2. Linear Regression
6.3. Cluster Analysis
6.4. k-Means Clustering
6.5. Association Analysis
6.6 Cluster Analysis in Spark

Text Books / Reference Books:

1. Jared Dean, Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners, 1st Edition, Wiley and SAS Business Series.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX

CO Statement (BCS-DS-825)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-825.1	3	2	1	1	1	1	1	2	1	1	1	3	2	1	1
BCS-DS-825.2	1	3	1	1	3	1	1	1	1	1	1	2	1	1	1
BCS-DS-825.3	2	1	2	1	1	3	3	1	1	1	1	3	1	1	1
BCS-DS-825.4	1	2	2	3	1	2	2	1	1	2	1	2	2	1	2
BCS-DS-825.5	1	1	2	3	3	1	1	2	2	2	1	2	1	1	1
BCS-DS-825.6	1	1	3	1	2	1	1	2	3	1	2	2	2	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-872: Machine Learning with Big Data Lab

Periods/week	Credits	Max. Marks	: 100
P :2	1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Sem Examination	: 50

Pre-Requisite: The ability to install applications and utilize a virtual machine is necessary to complete the hands-on assignments.
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-872.1. Understand, how to set up a KNIME Workspace and use Nodes in a Workflow.
BCS-DS-872.2. Categorize data exploration techniques.
BCS-DS-872.3. Demonstrate how to explore data using KNIME and Spark.
BCS-DS-872.4. Create a classification model in KNIME and Spark.
BCS-DS-872.5. Generate and interpret metrics to evaluate a model.
BCS-DS-872.6. Build a cluster analysis model in Spark

List of Experiments:-
1. Downloading and Installation of the Cloudera VM (Virtualbox) and Jupyter Notebook.
2. Download and install KNIME, setup KNIME workspace and navigate KNIME workbench, and use Nodes in a workflow.
3. Handling missing values in KNIME.
4. Handling missing values in Spark.
5. Classification using Decision Tree in KNIME.
6. Classification using Spark and comparing classification results for KNIME and Spark.
7. Evaluation of decision tree in KNIME and Spark.
8. Create an "elbow" plot, the number of clusters vs. within-cluster sum-of-squared errors, to determine a value for k, the number of clusters in k-means.
9. Implement cluster analysis on weather dataset using k-means in Spark.
10. Create parallel coordinates plots to analyse cluster centers.

Software required/Weblinks:
https://www.knime.org/downloads/overview?quicktabs_knimed=1#quicktabs-knimed
https://www.virtualbox.org/wiki/Downloads
https://downloads.cloudera.com/demo_vm/virtualbox/cloudera-quickstart-vm-5.4.2-0-virtualbox.zip.

For Cloudera Quickstart VM to run on a single system, it should have at least 8 GB of RAM. We can run this on a system with 4GB ram, but performance will be abysmal.

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Semester Practical Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-872)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-872.1	1	1	1	1	3	1	1	1	1	1	1	1	2	1	2
BCS-DS-872.2	2	2	1	2	3	1	1	1	1	1	2	2	2	1	2
BCS-DS-872.3	2	1	1	2	3	1	1	1	1	1	1	1	1	2	2
BCS-DS-872.4	3	2	2	1	3	1	1	1	2	1	2	1	1	1	1
BCS-DS-872.5	3	1	1	2	2	1	1	1	2	1	3	1	3	3	2
BCS-DS-872.6	3	2	1	3	3	2	1	1	2	1	2	1	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-826: Wireless and AD-Hoc Network

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of electronics
Course Type: Program Electives

Course Outcomes: Students will be able to-
BSC-CS-826.1. Learn Ad hoc network and Sensor Network fundamentals
BSC-CS-826.2. Understand the different routing protocols
BSC-CS-826.3. Apply an in-depth knowledge on sensor network architecture and design issues
BSC-CS-826.4. Examine the transport layer and security issues possible in Ad hoc and Sensor networks
BSC-CS-826.5. Develop to explore more programming platforms and tool
BSC-CS-826.6. Illustrate & Mange various Adhoc and sensor Attacks

PART-A

UNIT-1: AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS
1.1 Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks
1.2 Ad hoc wireless Internet
1.3 Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks
1.4 Classifications of Routing Protocols
1.5 Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

UNIT-2: SENSOR NETWORKS – INTRODUCTION ARCHITECTURES
2.1 Challenges for Wireless Sensor Networks
2.2 Enabling Technologies for Wireless Sensor Networks
2.3 WSN application examples, Single-Node Architecture – Hardware Components,
2.4 Energy Consumption of Sensor Nodes
2.5 Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

UNIT-3: WSN NETWORKING CONCEPTS AND PROTOCOLS
3.1 MAC Protocols for Wireless Sensor Networks
3.2 Low Duty Cycle Protocols And Wakeup Concepts – S-MAC
3.3 The Mediation Device Protocol
3.4 Contention based protocols – PAMAS, Schedule based protocols
3.5 Schedule based protocols - LEACH, MAC protocol, Routing Protocols, Energy Efficient Routing

PART-B

UNIT-4: SENSOR NETWORK SECURITY
4.1 Network Security Requirements
4.2 Issues and Challenges in Security Provisioning
4.3 Network Security Attacks,
4.4 Layer wise attacks in wireless sensor networks
4.5 Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

UNIT-5: SENSOR NETWORKS AND PLATFORM TOOLS
5.1 Sensor Node Hardware – Berkeley Motes
5.2 Programming Challenges
5.3 Node-level software platforms
5.4 Node-level Simulators – NS2 and its extension to sensor networks,
5.5 COOJA, TOSSIM

UNIT-6: ADHOC NETWORK ATTACKS

6.1 QoS Issue in Adhoc Networks: Introduction
6.2 Definition of QoS, Medium Access Layer
6.3 Q0S Routing, Inter- Layer Design Approaches
6.4 Security in Mobile Adhoc Networks: Vulnerabilities of Mobile Adhoc Networks
6.5 Potential Attacks, Attack Prevention Techniques. Intrusion Detection Techniques

Text Books / Reference Books:

1. Prasant Mohapatra and Srihanamurthy, 2009 "Ad Hoc Networks Technologies and Protocols", Springer, Springer International Edition.
2. Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks", A John Wiley & Sons, Inc., Publication-
3. Shivaram Murthy and B. S. Manoj, 2012 "Adhoc Networks – Principles and Protocols", Pearson Education.

Software required/Weblinks:

https://asurtowellmu.ga/mobile-ad-hoc-networks-tutorial-point.html
https://www.tutorialspoint.com/wireless_security/wireless_security_adhoc_connection_attack.html

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-826)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-826.1	2	1	-	1	-	-	2	-	1	1	-	2	-	-	2
BCS-DS-826.2	2	-	1	-	1	1	-	-	-	-	-	1	1	-	2
BCS-DS-826.3	2	2	-	1	1	1	-	-	-	-	-	2	1	-	-
BCS-DS-826.4	3	3	2	2	1	2	-	-	-	2	1	-	2	1	2
BCS-DS-826.5	2	-	3	-	-	-	1	-	-	-	-	2	1	1	-
BCS-DS-826.6	1	-	-	-	1	1	-	-	-	-	-	-	-	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

BCS-DS-827: Advanced Computer Architecture

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Computer Organization & Architecture (BCS-DS-402)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-827.1. Compare different types of parallelism.
BCS-DS-827.2. Analyze the various type of scheduling for computer architecture.
BCS-DS-827.3. Explain the cache memory organization.
BCS-DS-827.4. Examine the different types of processors.
BCS-DS-827.5. List the different generations of multi-computers.
BCS-DS-827.6. Proposed the architecture of the linear pipeline and nonlinear pipeline processors.

PART –A

Unit-1: Parallel Computer Models
1.1. Concept of Parallelism, the State of Computing,
1.2. Multiprocessors and Multicomputers,
1.3. Multivector and SIMD Computers,
1.4. PRAM and VLSI Models,
1.5. Architectural Development Tracks.

Unit-2: Program and Network Properties
2.1. Conditions of Parallelism,
2.2. Program Partitioning and Scheduling,
2.3. Program Flow Mechanisms,
2.4. System Interconnect Architectures.

Unit-3: Principles of Scalable Performance
3.1. Performance Metrics and Measures,
3.2. Parallel Processing Applications,
3.3. Speedup Performance Laws,
3.4. Scalability Analysis and Approaches.

PART –B

Unit-4: Processors and Memory Hierarchy
4.1. Advanced Processor Technology,
4.2. Superscalar and Vector Processors,
4.3. Memory Hierarchy Technology,
4.4. Virtual Memory Technology.

Unit-5: Bus, Cache, and Shared Memory
5.1. Backplane Bus Systems,
5.2. Cache Memory Organizations,
5.3. Shared-Memory Organizations,
5.4. Sequential and Weak Consistency Models.

Unit-6: Pipelining and Superscalar Techniques
6.1. Linear Pipeline Processors,
6.2. Nonlinear Pipeline Processors,
6.3. Instruction Pipeline Design,
6.4. Arithmetic Pipeline Design,
6.5. Superscalar and Super pipeline Design,
6.6. Overview of Parallel and Scalable Architectures,

6.7. Multiprocessors and Multicomputers, Multiprocessor System Interconnects,
6.8. Cache Coherence and Synchronization Mechanisms,
6.9. Three Generations of Multicomputers.

Text Books / Reference Books:

1. Kai Hwang , 2008, Advanced Computer Architecture: Parallelism, Scalability, Programmability : Second Edition, TMH
2. Michael J. Fiynn, 1995, Pipelined and Parallel processor design, I edition, Narosa.
3. Hwang & Briggs, 1993, Advance computer architecture, I edition, TMH

Software required/Weblinks:

csenote.weebly.com/advanced-computer-architecture.
https://www.annauniversityplus.com/plus/showthread.php

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-827)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-827.1	1	1	-	-	-	-	-	-	-	-	-	-	1	2	3
BCS-DS-827.2	-	-	2	3	-	2	-	-	-	-	-	-	-	3	-
BCS-DS-827.3	2	-	3	-	3	-	2	-	-	-	-	-	-	3	-
BCS-DS-827.4	1	-	3	-	-	2	-	-	-	-	-	-	-	2	2
BCS-DS-827.5	3	2	-	-	3	-	-	-	-	-	-	-	2	-	3
BCS-DS-827.6	1	2	3	-	-	-	-	-	-	-	-	-	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-828: Neural Networks and Deep Learning

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-828.1. Outline the basic concept of Neural network and Deep learning.
BCS-DS-828.2. Describe the biological neural network and to model equivalent neuron models.
BCS-DS-828.3. Differentiate various learning algorithm and issues of various feed forward and feedback neural networks.
BCS-DS-828.4. Apply Neural Networks and deep learning techniques to practical problems.
BCS-DS-828.5. Design the algorithms and techniques to solve real time problems
BCS-DS-828.6. Critically evaluate the complexities of various problems in different domains model performance and interpret results.

PART- A

UNIT – 1: Introduction of Neural Network
1.1 Human Brain, Models of a Neuron,
1.2 Neural Networks viewed as Directed Graphs,
1.3 Network Architectures,
1.4 Artificial Intelligence and Neural Networks Learning Process, Machine Learning
1.5 Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning
1.6 Credit Assignment Problem,
1.7 Memory, Adaption,
1.8 Statistical Nature of the Learning Process

UNIT – 2: Single Layer Perceptron
2.1 Adaptive Filtering Problem,
2.2 Unconstrained Organization Techniques,
2.3 Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques,
2.4 Perceptron –Convergence Theorem,
2.5 Relation Between Perceptron and Bayes Classifier for a Gaussian Environment
2.6 Multilayer Perceptron: Back Propagation
2.7Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule

UNIT – 3: Back Propagation:
3.1 Error Function and Activation Function
3.2 Back Propagation and Differentiation,
3.3 Feedforward Neural networks,
3.4 Gradient descent and the backpropagation algorithm.
3.5 Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning,
3.6 Accelerated Convergence

PART- B

Unit 4: Convolutional Neural Networks
4.1 Invariance, stability,
4.2 Variability models , deformation model, stochastic model,
4.3 Scattering networks,
4.4 Group Formalism,
4.5 Supervised Learning: classification,
4.6 Properties of CNN representations: invertibility, stability, invariance,
4.7 covariance/invariance: capsules and related models,
4.8 Other tasks: localization, regression,
4.9 Embeddings, inverse problems,

4.10 Extensions to non-Euclidean domains,

Unit 5: Recurrent Neural Networks
5.1 Building recurrent NN ,
5.2 Long Short-Term Memory,
5.3 Time Series Forecasting,

Unit 6 : Deep Unsupervised Learning
6.1 Autoencoders, standard, denoising, contractive, etc,
6.2 Variational Autoencoders
6.3 Adversarial Generative Networks
6.4 Maximum Entropy Distributions

Text Books/ Reference Books:

1. S. Haykin ,1999, Neural Networks: A Comprehensive Foundation 2nd edition, Prentice Hall, 1999.
2. Yoshua Bengio, and Aaron Courville, Jun 2019, Neural Networks and Deep Learning: an Goodfellow Josh Patterson, Adam Gibson, Sept 2017, Deep Learning, Oreilly.
3. K. Mehrotra, C. Mohan, and S. Ranka, 1997, Elements of Artificial Neural Networks, MIT Press.
4. B. Yegnanarayana, 2005, Artificial Neural Networks, Prentice Hall of India P Ltd.
5. Li Min Fu, 2003, Neural Networks in Computer Intelligence, TMH
6. James A Freeman David M S Kapura, 2004, Neural Networks, Pearson Education.
7. Jacek M. Zurada, 2006, Introduction to Artificial Neural Systems, JAICO Publishing House Ed.
8. Bengio, Yoshua ,2009, Learning deep architectures for AI " Foundations and trends in Machine Learning.
9. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach, 2017, Deep Learning :Adaptive Computation and Machine Learning series

Software required/Weblinks:
https://nptel.ac.in/courses/106/105/106105215/
https://github.com/joanbruna/stat212b

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-828)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-828.1	2	1	-	1	-	-	2	-	1	1	-	2	-	1	2
BCS-DS-828.2	2	-	1	-	1	1	-	-	-	-	-	1	1	-	2
BCS-DS-828.3	2	2	-	1	1	1	-	-	-	-	-	2	1	-	-
BCS-DS-828.4	3	3	2	2	1	2	-	-	-	1	1	1	2	1	2
BCS-DS-828.5	2	-	3	-	-	-	1	-	-	-	-	2	1	1	-
BCS-DS-828.6	1	-	-	-	1	1	-	-	-	-	-	-	1	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-829: Advanced Data Warehouse and Data Mining

Periods/week	Credits	Max. Marks	: 200
L :3 T: 0	3.0	Continuous Evaluation	: 100
Duration of Exam: 3 Hrs		End Sem Examination	: 100

Pre-Requisite: Data Warehouse (BCS-DS-531) and Data Mining (BCS-DS-632)
Course Type: Program Electives

Course Outcomes: Students will be able to-
BCS-DS-829.1. Design a data mart or data warehouse for any organization.
BCS-DS-829.2. Develop skills to write queries using DMQL.
BCS-DS-829.3. Extract knowledge using data mining techniques.
BCS-DS-829.4. Adapt to new data mining tools.
BCS-DS-829.5. Explore recent trends in data mining such as web mining, spatial-temporal mining.
BCS-DS-829.6. Understand where data mining can be applied.

PART- A

Unit-1: Introduction
1.1 Introduction : Fundamentals of data mining
1.2 Data Mining Functionalities
1.3 Major issues in Data Mining
1.4 Data Preprocessing: Needs Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction
1.5 Data Warehouse and OLAP Technology for Data Mining Data Warehouse
1.6 Multi-dimensional Data Model
1.7 Data Warehouse Architecture
1.8 Data Warehouse Implementation.

Unit-2: Data mining
2.1 Data Mining Primitives, Languages
2.2 System Architectures : Data Mining Primitives
2.3 Data Mining Query Languages, Designing Graphical User Interfaces Based on a Data Mining Query Language
2.4 Architectures of Data Mining Systems.
2.5 Concepts Description : Characterization and Comparison
2.6 Data Generalization and Summarization-Based Characterization
2.7 Analytical Characterization: Analysis of Attribute Relevance
2.8 Mining Class Comparisons: Discriminating between Different Classes

Unit-3: Association rule mining
3.1. Mining Association Rules in Large Databases :Association Rule Mining
3.2. Mining Single-Dimensional Boolean Association Rules from Transactional Databases
3.3. Mining Multilevel Association Rules from Transaction Databases
3.4. Mining Multidimensional Association Rules from Relational Databases
3.5. Data Warehouses Classification and Prediction : Issues Regarding

PART-B

Unit-4: Data mining techniques
4.1 Classification and Prediction
4.2 Classification by Decision Tree Induction
4.3 Bayesian Classification
4.4 Classification by Backpropagation
4.5 Other Classification Methods, Prediction
4.6 Classifier Accuracy.

Unit-5: Clustering

5.1 Cluster Analysis Introduction
5.2 Types of Data in Cluster Analysis
5.3 A Categorization of Major Clustering Methods
5.4 Partitioning Methods
5.5 Density-Based Methods
5.6 Grid-Based Methods
5.7 Model-Based Clustering Method
5.8 Outlier Analysis.

Unit-6: Mining complex types

6.1. Mining Complex Types of Data
6.2. Multidimensional Analysis
6.3. Descriptive Mining of Complex, Data Objects
6.4. Mining Spatial Databases
6.5. Mining Multimedia Databases
6.6. Mining Time-Series
6.7. Sequence Data
6.8. Mining Text Databases
6.9. Mining the World Wide Web.

Text Books / Reference Books:

1. JIAWEI HAN & MICHELINE KAMBER, Data Mining – Concepts and Techniques, Harcourt India.
2. MARGARET H DUNHAM, Data Mining Introductory and advanced topics, PEARSON EDUCATION.
3. ARUN K PUJARI, Data Mining Techniques, University Press.
4. SAM ANAHORY & DENNIS MURRAY, Data Warehousing in the Real World, Pearson Edn.

Software required/Weblinks:

www. 3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-829)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BCS-DS-829.1	3	-	2	-	-	-	-	-	-	-	1	1	1	-	2
BCS-DS-829.2	-	2	3	2	2	-	-	-	-	-	-	-	1	-	-
BCS-DS-829.3	-	-	-	3	3	-	-	-	-	-	2	-	2	-	3
BCS-DS-829.4	-	-	-	3	3	-	-	-	-	-	2	-	2	-	3
BCS-DS-829.5	-	-	-	3	3	-	-	-	2	-	2	-	-	-	2
BCS-DS-829.6	-	-	-	3	3	-	-	-	2	-	2	-	-	-	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BCS-DS-830: Grid Computing

Periods/week Credits	Max. Marks : 200
L :3 T: 0 3.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs	End Sem Examination : 100

Pre-Requisite: Basic Knowledge of computers
Course Type: Program Electives

Course Outcomes: Students will be able to-

BCS-DS-830.1. Evaluate enabling technologies such as high-speed links and storage area networks for building computer grids.
BCS-DS-830.2. Apply grid computing and clustering middleware, such as Parallel Virtual Machine (PVM), Message Passing Interface (MPI), HPC Portals, and Peer-to-Peer networks for implementing virtual super computing resources.
BCS-DS-830.3. Design a grid computing application in one of the key application areas.
BCS-DS-830.4. Interpret a grid computing environment.
BCS-DS-830.5. Develop communications skills and accept the code of professional conduct and practice through short presentations and group work.
BCS-DS-830.6. Manage Resource scheduling & load balancing

PART- A

Unit-1: Introduction to Grid Computing

1.1. Introduction to Grid Computing
1.2. Benefits of Grid Computing
1.3. Virtual organization
1.4. Grid Application Areas
1.5. Introduction to semantic Grids
1.6. Grid Architecture & its relationship to other distributed technologies

Unit-2: Concepts And Architecture

2.1 Introduction – Characterization of grid, Grid related standards bodies, Architecture
2.2 Concepts of Parallel and Distributed Computing
2.3 Grid Computing - Anatomy of the grid – Introduction, Emergence of virtual organizations
2.4 Anatomy of the grid – Nature of grid architecture, Grid architecture description
2.5 Review of Web Services – SOAP, WSDL, UDDI, WS-Inspection and web services implementation
2.6 OGSA – DAI, WSRF

Unit-3: Data Management & Grid Portals

3.1. Data Management - Categories and Origins of Structured Data
3.2. Data Management - Challenges
3.3. Data Management - Architectural Approaches
3.4. Data Management - Collective Data Management Services
3.5. Data Management - Federation Services
3.6. Grid Portals – Introduction
3.7. Grid Portals - First & Second-Generation Grid Portals

PART –B

Unit-4: Grid Security

4.1 Grid Security – Introduction, A Brief Security Primer and Cryptography Array based implementation of graphs:
4.2 Grid Security - PKI-X509 Certificates
4.3 Grid Security – Grid Security Infrastructure (GSI), Authorization modes
4.4 Grid Security - Certificates

Unit-5: Grid Scheduling & Resource Management

5.1. Grid Scheduling and Resource Management - Introduction, Scheduling Paradigms

5.2. Grid Scheduling and Resource Management - Working principles of Scheduling.
5.3. Grid Scheduling and Resource Management - Condor – Architecture, Daemons, Job life cycle, Security issue and job management
5.4. A Review of Condor, SGE, PBS and LSF
5.5. Grid Scheduling with QoS - Nimrod/G, Rescheduling, Scheduling with heurisitcs

Unit-6: Grid Middleware
6.1. List of globally available Middlewares
6.2. Case Studies – Globus Toolkit – GT4 Software architecture model
6.3. Hash Globus Toolkit – GT4 Software architecture model - Load balancing
6.4. Globus GT4 Toolkit : Programming Model
6.5. Globus GT3 Toolkit : Implementation
6.6. Globus GT4 Toolkit : High-level services

Text Books / Reference Books:

1. Maozhen Li, Mark Baker,2005, The Grid Core Technologies: 1st Edition, John Wiley & Sons.
2. Joshy Joseph & Craig Fellenste ,2004 , Grid Computing, Pearson Education.
3. Ian Foster & Carl Kesselman, 2004, The Grid 2 – Blueprint for a New Computing Infrascture, 2nd Edition.
4. Fran Berman, Geoffrey Fox, Anthony J.G.Hey, 2003, Grid Computing: Making the Infrastructure a Reality, John Wiley & Sons

Software required/Weblinks:
https://www.peterindia.net/GridComputingLinks.html
https://boinc.berkeley.edu/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
End Semester Examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-DS-830)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BCS-DS-830.1	3	-	2	-	-	-	-	-	-	-	-	-	-	1	-
BCS-DS-830.2	2	1	-	-	2	-	-	3	-	-	-	-	-	-	-
BCS-DS-830.3	2	3	2	1	-	-	-	-	-	-	-	-	-	-	3
BCS-DS-830.4	-	-	-	-	3	-	2	2	-	-	-	-	3	-	-
BCS-DS-830.5	1	1	-	-	-	-	-	-	2	3	-	-	-	1	2
BCS-DS-830.6	-	-	-	-	-	-	-	-	-	-	-	1	-	2	1