BANASTHALI VIDYAPITH

Bachelor of Technology
(Computer Science and Engineering/Information Technology)

Curriculum Structure

First Semester Examination, December, 2019
Second Semester Examination, April/May, 2020
Third Semester Examination, December, 2020
Fourth Semester Examination, April/May, 2021
Fifth Semester Examination, December, 2021
Sixth Semester Examination, April/May, 2022
Seventh Semester Examination, December, 2022
Eighth Semester Examination, April/May, 2023

BANASTHALI VIDYAPITH
P.O. BANASTHALI VIDYAPITH
(Rajasthan)-304022

July, 2019

69

No. F. 9-6/81-U.3

Government of India
Ministry of Education and Culture
(Department of Education)

New Delhi, the 25th October, 1983

N O T I F I C A T I O N

In exercise of the powers conferred by Section 3 of the University Grants Commission Act, 1956 (3 of 1956) the Central Government, on the advice of the Commission, hereby declare that Banasthali Vidyapith, P. O. Banasthali Vidyapith, (Rajasthan) shall be deemed to be a University for the purpose of the aforesaid Act.

Sd/-
(M. R. Kolhatkar)
Joint Secretary of the Government of India

N O T I C E

Changes in Bye-laws/Syllabi and Books may from time to time be made by amendment or remaking, and a Candidate shall, except in so far as the Vidyapith determines otherwise, comply with any change that applies to years she has not completed at the time of change.

CONTENTS

Discipline Electives

Reading Electives

B. Tech. Computer Science and Engineering

Programme Educational Objectives

Banasthali Vidyapith aims at the synthesis of spiritual values and scientific achievements. Its educational programme is based on the concept of *Panchmukhi Shiksha*(Physical, Practical, Aesthetic, Moral and Intellectual) and aims at all round harmonious development of personality. Banasthali Vidyapith aims to encourage research and innovation in Computer Science, Information Technology and allied areas.

The objective of the B.Tech. programmes in Computer Science Engineering is to prepare students to undertake careers involving innovation and problem solving using computational techniques and technologies, or to undertake advanced studies for research careers or to take up Entrepreneurship. In order to give due importance to applied as well as theoretical aspects of computing, the curriculum for the B.Tech. (CSE) programme covers most of the foundational aspects of computing sciences, and also develops in students the engineering skills for problem solving.

B.Tech. (CSE) programme at Banasthali Vidyapith starts with courses in Sciences, and then migrate to specialized courses for the disciplines. B.Tech. (CSE) programme first focuses on building the foundations in a highly structured manner, and then for developing the skills and knowledge of the students in various computing and application domains. A limited number of specializations are also provided and different students may follow different paths and take different set of courses.

The main objectives of the programme are:

- To bring the physical, analytical and computational approaches of Computer Science Engineering in order to bear on the challenges the students take on, abstracting essential structure, recognizing sources of uncertainty, and applying appropriate models, technical tools, and evaluations to develop their solutions.
- To bring to students careers the self-assurance, integrity, and technical strengths that drive innovation, and the communication and collaboration skills to inspire and guide the groups they work with in bringing their ideas to fruition.
- To develop abilities and talents in students leading to creativity and productivity in fields and professions beyond the regular curriculum.

- To promote life-long self learning abilities in students to remain professionally effective to the society at large.
- To promote among student graduates the ability to gain multidisciplinary knowledge through projects and industrial training, leading to a sustainable competitive edge in R&D and meeting societal needs.
- To inculcate group work and team management skills with cross-cultural etiquettes in students, promoting knowledge transfer leading to conceptualization and delivery of projects with varied complexity.
- To sensitize students towards issues of social relevance, openness to other international cultures and to introduce them to professional ethics and practice.

Programme Outcomes

A Computer Science Engineering graduate will achieve the following:

PO1. **Engineering knowledge:** Apply the knowledge of mathematics, science, and computer science to the solution of computer science engineering problems.

PO2. **Problem analysis**: Identify, formulate and develop solutions to computational challenges.

PO3. **Design/development of solutions**: Design, implement and evaluate computational systems and system components/processes that meet the desired needs within realistic constraints.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Select and apply appropriate techniques, resources and engineering tools to engineering activities with an understanding of their limitations.

PO6. **The engineer and society**: Understanding of professional, ethical, legal, security and social issues and responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge for sustainable development.

PO8. **Ethics**: Commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual as well as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on engineering activities with the engineering community and with the society at large, work collaboratively and exhibit high levels of professionalism.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.

PO12. **Life-long learning:** Able to engage in independent and life-long learning to adapt to the rapidly changing engineering scenario.

B. Tech. Information Technology
Programme Educational Objectives

Banasthali Vidyapith aims at the synthesis of spiritual values and scientific achievements. Its educational programme is based on the concept of *PanchmukhiShiksha*(Physical, Practical, Aesthetic, Moral and Intellectual) and aims at all round harmonious development of personality. Banasthali Vidyapith aims to encourage research and innovation in Computer Science, Information Technology and allied areas.

The objective of the B.Tech.programmes in Information Technology is to prepare students to undertake careers involving innovation and problem solving using computational techniques and technologies, or to undertake advanced studies for research careers or to take up Entrepreneurship. In order to give due importance to applied as well as theoretical aspects of computing, the curriculum for the B.Tech. (IT) programme covers most of the foundational aspects of information technology, and also develops in students the engineering skills for problem solving.

The B.Tech. (IT) programme at Banasthali Vidyapith starts with courses in Sciences, and then migrate to specialized courses for the disciplines. The B.Tech. (IT) programme first focuses on building the foundations in a highly structured manner, and then for developing the skills and knowledge of the students in various computing and application domains. A limited number of specializations are also provided and different students may follow different paths and take different set of courses.

The main objectives of the programme are:

- To provide student graduates with a solid foundation in mathematical, scientific and engineering fundamentals required to develop problem solving ability.
- To prepare student graduates for a successful career with effective communication skills, teamwork skills and work with values that meet the diversified needs of industry, academia and research.
- To train students in comprehending, analyzing, designing and creating novel products and technologies that provide solution frameworks to real world problems.
- To promote awareness among student graduates towards issues of social relevance and introduce them to professional ethics and practice.
- To inculcate in student graduates the ability to gain multidisciplinary knowledge through projects and industrial training, providing a sustainable competitive edge in R&D and meeting industry needs.
- To develop self-learning ability in graduates by inculcating the philosophy to continuously learn, innovate and contribute to creation of new knowledge for the benefit of the society at large.
- To inculcate in graduates the qualities of leadership for technology innovation and entrepreneurship.

Programme Outcomes

An Information Technology graduate will achieve the following:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, and computer science to the solution of computer science engineering problems.

PO2. **Problem analysis**: Identify, formulate and develop solutions to computational challenges.

PO3. **Design/development of solutions**: Design, implement and evaluate computational systems and system components/processes that meet the desired needs within realistic constraints.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Select and apply appropriate techniques, resources and engineering tools to engineering activities with an understanding of their limitations.

PO6. **The engineer and society**: Understanding of professional, ethical, legal, security and social issues and responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge for sustainable development.

PO8. **Ethics**: Commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual as well as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on engineering activities with the engineering community and with the society at large, work collaboratively and exhibit high levels of professionalism.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.

PO12. **Life-long learning:** Able to engage in independent and life-long learning to adapt to the rapidly changing engineering scenario.

B. Tech. Computer Science and Engineering

Semester – I

Course Code	Course Name	L	T	P	C*
BVF 014/ BVF 011	General English/सामान्य हिन्दी	2	0	0	2
	Core Foundation Course-I	2	0	0	2
MATH 103/ MATH 107	Calculus/Linear Algebra	3	1	0	4
PHY 101/ PHY 106	Applied Optics/Modern Physics	3	1	0	4
CHEM 101/ BIO 101	Chemistry/Biology	3	1	0	4
CHE 102/ PHY 109	Thermodynamics/Engineering Mechanics	3	1	0	4
CS 109/ EEE 101	Computer Fundamentals and Programming/Electrical Engineering	4	0	0	4
CS 109L/ EEE 101L	Computer Fundamentals and Programming Lab/Electrical Engineering Lab	0	0	4	2
ENGG 101L/ ENGG 103L	Engineering Drawing and Graphics Lab/Measurement Techniques Lab	0	0	6	3
	Semester Total:	**20**	**4**	**10**	**29**

Semester – II

Course Code	Course Name	L	T	P	C*
BVF 011/ BVF 014	सामान्य हिन्दी / General English	2	0	0	2
	Core Foundation Course-II	2	0	0	2
MATH 107/ MATH 103	Linear Algebra/Calculus	3	1	0	4
PHY 106/ PHY 101	Modern Physics/ Applied Optics	3	1	0	4
BIO 101/ CHEM 101	Biology/Chemistry	3	1	0	4
PHY 109/ CHE 102	Engineering Mechanics/ Thermodynamics	3	1	0	4
EEE 101/ CS 109	Electrical Engineering/Computer Fundamentals and Programming	4	0	0	4
EEE 101L/ CS 109L	Electrical Engineering Lab/Computer Fundamentals and Programming Lab	0	0	4	2
ENGG 103L/ ENGG 101L	Measurement Techniques Lab / Engineering Drawing and Graphics Lab	0	0	6	3
	Semester Total:	**20**	**4**	**10**	**29**

Semester – III

Course Code	Course Name	L	T	P	C*
	Core Foundation Course - III	2	0	0	2
	Elective Foundation Course - I	2	0	0	2
MATH 209/ MATH 210	Complex Variables/ Differential Equations	3	1	0	4
ENGG 201/ ENGG 202	Structure and Properties of Materials/ Basic Electronics	4	0	0	4
MATH 211	Introduction to Discrete Mathematics	3	1	0	4
CS 207	Computer Organization and Architecture	4	0	0	4
CS 209	Data Structures	4	0	0	4
CS 209L	Data Structures Lab	0	0	4	2
CS 212	Database Management System	4	0	0	4
CS 212L	Database Management System Lab	0	0	4	2
	Semester Total:	**26**	**2**	**8**	**32**

Semester - IV

Course Code	Course Name	L	T	P	C*
	Core Foundation Course - IV	2	0	0	2
	Elective Foundation Course - II	2	0	0	2
MATH 210/ MATH 209	Differential Equations/ Complex Variables	3	1	0	4
ENGG 202/ ENGG 201	Basic Electronics/ Structure and Properties of Materials	4	0	0	4
CS 313	Software Engineering	4	0	0	4
CS 213	Design and Analysis of Algorithms	4	0	0	4
CS 213L	Design and Analysis of Algorithms Lab	0	0	4	2
CS 214	Object Oriented Programming	4	0	0	4
CS 214L	Object Oriented Programming Lab	0	0	4	2
CS 216	Systems Programming	4	0	0	4
	Semester Total:	**27**	**1**	**8**	**32**

Semester - V

Course Code	Course Name	L	T	P	C*
	Vocational Course - I	2	0	0	2
	Core Foundation Course - V/ Elective Foundation Course - III	2	0	0	2
ECO 307/ MGMT 310	Fundamentals of Economics/ Principles of Management	3	0	0	3
MATH 311/ STAT 204	Numerical Methods/ Probability and Statistical Methods	3	1	0	4
CS 304	Java Programming	4	0	0	4
CS 304L	Java Programming Lab	0	0	6	3
CS 302	Data Communication and Networks	4	0	0	4
CS 308	Operating Systems	4	0	0	4
CS 324L	Operating Systems Lab	0	0	2	1
CS 312S	Seminar	0	0	4	2
	Semester Total:	**22**	**1**	**12**	**29**

Semester - VI

Course Code	Course Name	L	T	P	C*
	Vocational Course - II	2	0	0	2
	Elective Foundation Course - III/ Core Foundation Course - V	2	0	0	2
MGMT 310/ ECO 307	Principles of Management/ Fundamentals of Economics	3	0	0	3
STAT 204/ MATH 311	Probability and Statistical Methods/Numerical Methods	3	1	0	4
CS 315	Theory of Computation	4	0	0	4
CS 317	Artificial Intelligence and Machine Learning	4	0	0	4
CS 317L	Artificial Intelligence and Machine Learning Lab	0	0	4	2
ELE 509	Microprocessors and Microcontrollers	4	0	0	4
ELE 306L	Microprocessors and Microcontrollers Lab	0	0	2	1
CS 311P	Project	0	0	8	4
	Semester Total:	**22**	**1**	**14**	**30**

Semester - VII

Course	Code	Course Name	L	T	P	C*
CS	449P	UIL Project	0	0	48	24
		Reading Elective	0	0	0	2
		Semester Total:	**0**	**0**	**48**	**26**

List of Reading Electives

Course	Code	Course Name	L	T	P	C*
CS	404R	Client-Server Computing and Applications	0	0	0	2
CS	444R	Parallel Computing	0	0	0	2
IT	402R	Electronic Commerce	0	0	0	2
IT	403R	Enterprise Resource Planning	0	0	0	2

Online Reading Electives

Agile Software Development	0	0	0	2
Organizational Behavior	0	0	0	2
Software as a Service	0	0	0	2
Blockchain	0	0	0	2

Semester - VIII

Course	Code	Course Name	L	T	P	C*
CS	405	Compiler Design	4	0	0	4
CS	439L	Compiler Design Lab	0	0	2	1
CS	411	Computer Graphics	4	0	0	4
CS	411L	Computer Graphics Lab	0	0	4	2
CS	508	Big Data Analytics	4	0	0	4
CS	508L	Big Data Analytics Lab	0	0	6	3
		Discipline Elective	4	0	0	4
		Open Elective	4	0	0	4
		Semester Total:	**20**	**0**	**12**	**26**

List of Discipline Electives

Course Code		Course Name	L	T	P	C*
CS	441	Computer Vision	4	0	0	4
CS	419	Distributed Computing	4	0	0	4
CS	602	Digital Image Processing	4	0	0	4
CS	431	Real Time Systems	4	0	0	4
CS	433	Soft Computing	4	0	0	4
IT	412	Internet of Things	4	0	0	4
CS	445	Pattern Recognition	4	0	0	4
IT	401	Data Mining and Warehousing	4	0	0	4
RS	401	Geoinformatics	4	0	0	4
CS	528	Modeling and Simulation	4	0	0	4
MCTR	403	Robotics and Automation	4	0	0	4

*** L - Lecture hrs/week; T - Tutorial hrs/week; P-Project/Practical/Lab/All other non-classroom academic activities, etc. hrs/week; C - Credit Points of the Course**

Student can opt open (Generic) elective from any discipline of the Vidyapith with prior permission of respective heads and time table permitting.

Every Student shall also opt for:
Five Fold Education: Physical Education I, Physical Education II, Five Fold Education: Aesthetic Education I, Aesthetic Education II, Five Fold Education: Practical Education I, Practical Education II one each semester

B. Tech. Information Technology

Semester – I

Course Code		Course Name	L	T	P	C*
BVF BVF	014/ 011	General English/ सामान्य हिन्दी	2	0	0	2
		Core Foundation Course-I	2	0	0	2
MATH MATH	103/ 107	Calculus/Linear Algebra	3	1	0	4
PHY PHY	101/ 106	Applied Optics/Modern Physics	3	1	0	4
CHEM BIO	101/ 101	Chemistry/Biology	3	1	0	4
CHE PHY	102/ 109	Thermodynamics/Engineering Mechanics	3	1	0	4
CS EEE	109/ 101	Computer Fundamentals and Programming/Electrical Engineering	4	0	0	4
CS EEE	109L 101L	Computer Fundamentals and Programming Lab/Electrical Engineering Lab	0	0	4	2
ENGG ENGG	101L/ 103L	Engineering Drawing and Graphics Lab/ Measurement Techniques Lab	0	0	6	3
		Semester Total:	**20**	**4**	**10**	**29**

Semester – II

Course	Code	Course Name	L	T	P	C*
BVF BVF	014/ 011	सामान्य हिन्दी / General English	2	0	0	2
		Core Foundation Course-II	2	0	0	2
MATH MATH	107/ 103	Linear Algebra/Calculus	3	1	0	4
PHY PHY	106/ 101	Modern Physics/ Applied Optics	3	1	0	4
BIO CHEM	101/ 101	Biology/Chemistry	3	1	0	4
PHY CHE	109/ 102	Engineering Mechanics/ Thermodynamics	3	1	0	4
EEE CS	101/ 109	Electrical Engineering/Computer Fundamentals and Programming	4	0	0	4
EEE CS	101L/ 109L	Electrical Engineering Lab/Computer Fundamentals and Programming Lab	0	0	4	2
ENGG ENGG	103L/ 101L	Measurement Techniques Lab/ Engineering Drawing and Graphics Lab	0	0	6	3
		Semester Total:	**20**	**4**	**10**	**29**

Semester – III

Course Code	Course Name	L	T	P	C*
	Core Foundation Course - III	2	0	0	2
	Elective Foundation Course - I	2	0	0	2
MATH 209/ MATH 210	Complex Variables/ Differential Equations	3	1	0	4
ENGG 201/ ENGG 202	Structure and Properties of Materials/ Basic Electronics	4	0	0	4
MATH 211	Introduction to Discrete Mathematics	3	1	0	4
CS 207	Computer Organization and Architecture	4	0	0	4
CS 209	Data Structures	4	0	0	4
CS 209L	Data Structures Lab	0	0	4	2
CS 212	Database Management System	4	0	0	4
CS 212L	Database Management System Lab	0	0	4	2
	Semester Total:	**26**	**2**	**8**	**32**

Semester - IV

Course Code	Course Name	L	T	P	C*
	Core Foundation Course - IV	2	0	0	2
	Elective Foundation Course - II	2	0	0	2
MATH 210/ MATH 209	Differential Equations/ Complex Variables	3	1	0	4
ENGG 202/ ENGG 201	Basic Electronics/ Structure and Properties of Materials	4	0	0	4
CS 313	Software Engineering	4	0	0	4
CS 213	Design and Analysis of Algorithms	4	0	0	4
CS 213L	Design and Analysis of Algorithms Lab	0	0	4	2
CS 214	Object Oriented Programming	4	0	0	4
CS 214L	Object Oriented Programming Lab	0	0	4	2
CS 216	Systems Programming	4	0	0	4
	Semester Total:	**27**	**1**	**8**	**32**

Semester - V

Course	Code	Course Name	L	T	P	C*
		Vocational Course - I	2	0	0	2
		Core Foundation Course - V/ Elective Foundation Course - III	2	0	0	2
ECO / MGMT	307/ 310	Fundamentals of Economics/ Principles of Management	3	0	0	3
MATH / STAT	311/ 204	Numerical Methods/ Probability and Statistical Methods	3	1	0	4
CS	304	Java Programming	4	0	0	4
CS	304L	Java Programming Lab	0	0	6	3
CS	302	Data Communication and Networks	4	0	0	4
CS	308	Operating Systems	4	0	0	4
CS	324L	Operating Systems Lab	0	0	2	1
IT	303S	Seminar	0	0	4	2
		Semester Total:	**22**	**1**	**12**	**29**

Semester - VI

Course	Code	Course Name	L	T	P	C*
		Vocational Course - II	2	0	0	2
		Elective Foundation Course - III/ Core Foundation Course - V	2	0	0	2
MGMT / ECO	310 / 307	Principles of Management/ Fundamentals of Economics	3	0	0	3
STAT / MATH	204/ 311	Probability and Statistical Methods/Numerical Methods	3	1	0	4
CS	315	Theory of Computation	4	0	0	4
CS	317	Artificial Intelligence and Machine Learning	4	0	0	4
CS	317L	Artificial Intelligence and Machine Learning Lab	0	0	4	2
IT	302	Internet and Web Technology	4	0	0	4
IT	302L	Internet and Web Technology Lab	0	0	4	2
CS	311P	Project	0	0	8	4
		Semester Total:	**22**	**1**	**16**	**31**

Semester - VII

Course Code		Course Name	L	T	P	C*
CS	411	Computer Graphics	4	0	0	4
CS	411L	Computer Graphics Lab	0	0	4	2
IT	410	Information Systems and Securities	4	0	0	4
IT	401	Data Mining and Warehousing	4	0	0	4
IT	401L	Data Mining and Warehousing Lab	0	0	4	2
		Discipline Elective	4	0	0	4
		Open Elective	4	0	0	4
		Semester Total:	**20**	**0**	**8**	**24**

List of Discipline Electives

Course Code		Course Name	L	T	P	C*
CS	441	Computer Vision	4	0	0	4
CS	405	Compiler Design	4	0	0	4
CS	419	Distributed Computing	4	0	0	4
CS	602	Digital Image Processing	4	0	0	4
CS	431	Real Time Systems	4	0	0	4
CS	433	Soft Computing	4	0	0	4
IT	412	Internet of Things	4	0	0	4
CS	445	Pattern Recognition	4	0	0	4
RS	401	Geo informatics	4	0	0	4
IT	413	Multimedia Systems	4	0	0	4
CS	528	Modeling and Simulation	4	0	0	4
MCTR	403	Robotics and Automation	4	0	0	4
CS	508	Big Data Analytics	4	0	0	4

Semester - VIII

Course Code		Course Name	L	T	P	C*
IT	415P	UIL Project	0	0	48	24
		Reading Elective	0	0	0	2
		Semester Total:	**0**	**0**	**48**	**26**

List of Reading Electives

Course Code		Course Name	L	T	P	C*
CS	404R	Client-Server Computing and Applications	0	0	0	2
CS	444R	Parallel Computing	0	0	0	2
IT	402R	Electronic Commerce	0	0	0	2
IT	403R	Enterprise Resource Planning	0	0	0	2
IT	404R	IT in Bussiness	0	0	0	2

Online Reading Electives

	Course Name	L	T	P	C*
	Agile Software Development	0	0	0	2
	Organizational Behavior	0	0	0	2
	Software as a Service	0	0	0	2
	Blockchain	0	0	0	2

*** L - Lecture hrs/week; T - Tutorial hrs/week; P-Project/Practical/Lab/All other non-classroom academic activities, etc. hrs/week; C - Credit Points of the Course**

Student can opt open (Generic) elective from any discipline of the Vidyapith with prior permission of respective heads and time table permitting.

Every Student shall also opt for:
Five Fold Education: Physical Education I, Physical Education II, Five Fold Education: Aesthetic Education I, Aesthetic Education II, Five Fold Education: Practical Education I, Practical Education II one each semester

Five Fold Activities

Fine Arts		Physical Education and Sports	
BVFF 101	Classical Dance (Bharatnatyam)	BVFF 201	Aerobics
BVFF 102	Classical Dance (Kathak)	BVFF 202	Archery
BVFF 103	Classical Dance (Manipuri)	BVFF 203	Athletics
BVFF 104	Creative Art	BVFF 204	Badminton
BVFF 105	Folk Dance	BVFF 205	Basketball
BVFF 106	Music-Instrumental (Guitar)	BVFF 206	Cricket
BVFF 107	Music-Instrumental (Orchestra)	BVFF 207	Equestrian
BVFF 108	Music-Instrumental (Sarod)	BVFF 208	Flying - Flight Radio Telephone Operator's Licence (Restricted)
BVFF 109	Music-Instrumental (Sitar)	BVFF 209	Flying - Student Pilot's Licence
BVFF 110	Music-Instrumental (Tabla)	BVFF 229	Aeromodelling
BVFF 111	Music-Instrumental (Violin)	BVFF 210	Football
BVFF 112	Music-Vocal	BVFF 211	Gymnastics
BVFF 113	Theatre	BVFF 212	Handball
		BVFF 213	Hockey
Social Service and Extension Activities		BVFF 214	Judo
BVFF 301	Banasthali Sewa Dal	BVFF 215	Kabaddi
BVFF 302	Extension Programs for Women Empowerment	BVFF 216	Karate – Do
BVFF 303	FM Radio	BVFF 217	Kho-Kho
BVFF 304	Informal Education	BVFF 218	Net Ball
BVFF 305	National Service Scheme	BVFF 219	Rope Mallakhamb
BVFF 306	National Cadet Corps	BVFF 220	Shooting
		BVFF 221	Soft Ball
		BVFF 222	Swimming
		BVFF 223	Table Tennis
		BVFF 224	Tennis
		BVFF 225	Throwball
		BVFF 226	Volleyball
		BVFF 227	Weight Training
		BVFF 228	Yoga

Evaluation Scheme and Grading System

Continuous Assessment (CA) (Max. Marks)					End-Semester Assessment (ESA) (Max. Marks)	Grand Total (Max. Marks)
Assignment		Periodical Test		Total (CA)		
I	II	I	II			
10	10	10	10	40	60	100

In all theory, laboratory and other non classroom activities (project, dissertation, seminar, etc.), the Continuous and End-semester assessment will be of 40 and 60 marks respectively. However, for Reading Elective, only End semester exam of 100 marks will be held. Wherever desired, the detailed breakup of continuous assessment marks (40), for project, practical, dissertation, seminar, etc shall be announced by respective departments in respective student handouts.

Based on the cumulative performance in the continuous and end-semester assessments, the grade obtained by the student in each course shall be awarded. The classification of grades is as under:

Letter Grade	Grade Point	Narration
O	10	Outstanding
A+	9	Excellent
A	8	Very Good
B+	7	Good
B	6	Above Average
C+	5	Average
C	4	Below Average
D	3	Marginal
E	2	Exposed
NC	0	Not Cleared

Based on the obtained grades, the Semester Grade Point Average shall be computed as under:

$$SGPA = \frac{CC_1 * GP_1 + CC_2 * GP_2 + CC_3 * GP_3 + ---- + CC_n * GP_n}{CC_1 + CC_2 + CC_3 + ---- + CC_n} = \frac{\sum_{i=1}^{n} CC_i * GP_i}{\sum_{i=1}^{n} CC_i}$$

Where n is the number of courses (with letter grading) registered in the semester, CC_i are the course credits attached to the i^{th} course with letter

grading and GP_i is the letter grade point obtained in the i^{th} course. The courses which are given Non-Letter Grades are not considered in the calculation of SGPA.

The Cumulative Grade Point Average (CGPA) at the end of each semester shall be computed as under:

$$CGPA = \frac{CC_1 * GP_1 + CC_2 * GP_2 + CC_3 * GP_3 + ---- + CC_n * GP_n}{CC_1 + CC_2 + CC_3 + ---- + CC_n} = \frac{\sum_{i=1}^{n} CC_i * GP_i}{\sum_{i=1}^{n} CC_i}$$

Where n is the number of all the courses (with letter grading) that a student has taken up to the previous semester.

Student shall be required to maintain a minimum of 4.00 CGPA at the end of each semester. If a student's CGPA remains below 4.00 in two consecutive semesters, then the student will be placed under probation and the case will be referred to Academic Performance Review Committee (APRC) which will decide the course load of the student for successive semester till the student comes out of the probationary clause.

To clear a course of a degree program, a student should obtain letter grade C and above. However, D/E grade in two/one of the courses throughout the UG/PG degree program respectively shall be deemed to have cleared the respective course(s). The excess of two/one D/E course(s) in UG/PG degree program shall become the backlog course(s) and the student will be required to repeat and clear them in successive semester(s) by obtaining grade C or above.

After successfully clearing all the courses of the degree program, the student shall be awarded division as per following table.

Division	CGPA
Distinction	7.50 and above
First Division	6.00 to 7.49
Second Division	5.00 to 5.99
Pass	4.00 to 4.99

CGPA to % Conversion Formula: % of Marks Obtained = CGPA * 10

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Detailed Syllabus

MATH 103 Calculus

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

After successful completion of the course, students will be able to:

- Define limit, infinite series and sequence of partial sums of an infinite series, Convergence and Divergence of an infinite series.
- Relate the limit of a function at a point to the limit of a sequence at that point and tell when a function will fail to have a limit at a point.
- Define monotonic functions and find a connection between monotonicity of a function and derivative of a function.
- Demonstrate the concept of Divergence, Curl, Green's theorem, Stokes's theorem.

Section A

Sequences, series, test for convergence, power series, radius of convergence; limit, continuity and differentiability (analytic definitions with simple examples); Rolle's Theorem, mean value theorem and Taylor's theorem; Successive differentiation: Leibnitz' theorem (without proof).

Section B

Review of vectors, Cylinders and quadric surfaces, Vector functions of one variable and their derivatives,Partial derivatives: Chain rule, exact differentials, Gradient, Directional derivative, Tangent planes and normals, Maxima and minima (two variables) including Lagrange's multipliers, Asymptotes and Curve tracing.

Section C

Riemann integral and the fundamental theorem of integral calculus, Reduction Formulae, Multiple integrals, Applications to multiple integrals to find length, area, surface area, volume, surface area of revolution, Improper integral.

Vector fields, Surface integral, Line integral, Independence of path, Conservative fields, Divergence, Curl, Green's theorem, Stokes's theorem.

Suggested Books:

1. Thomas, G.B., Weir, M.D., & Hass, J. (2011). *Thomas' Calculus* (11th ed.).Boston, MA: Pearson Education, Inc.

2. Kreyszig, E. (2011). *Advanced Engineering Mathematics* (9th ed.). Hoboken, NJ : John Wiley & Sons, Inc.

3. Apostol, T.M. (1980). *Calculus* (2nded.). New York, NY: John Wiley & Sons, Inc.

4. Grewal, B.S., & Grewal, J.S. (2012). Higher Engineering Mathematics (42thed.). India, Delhi: Khanna Publishers.

Suggested E-Learning Material:

1. Differentiation and Integration of Vector Functions

   http://vle.du.ac.in/pluginfile.php/837/mod_resource/content/0/Differentiation%20and%20Integration%20of%20Vector%20Functions.pdf

2. Mean Value Theorems

   http://vle.du.ac.in/pluginfile.php/844/mod_resource/content/0/Mean%20Value%20Theorems.pdf

3. Infinite Series

   http://vle.du.ac.in/pluginfile.php/861/mod_resource/content/0/Infinite%20Series.pdf

MATH 107 Linear Algebra

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

After successful completion of the course, students will be able to:

- Define basic terms and concepts of matrices, vectors and complex numbers
- Use basic vector space concepts such as linear space, linear dependence, basis, dimension, linear transformation;
- Be familiar with the concepts of eigenvalue, eigenspace and eigenvector and know how to compute these objects;
- Use the characteristic polynomial to compute the eigenvalues and eigenvectors of a square matrix and use them to diagonalise matrices when this is possible; discriminate between iagonalizable and non-diagonalisable matrices.
- Use gauss-jordan elimination to solve systems of linear equations and to compute the inverse of an invertible matrix

Section A

Vectors, Algebra of vectors, vector spaces, subspaces, Linear sum and direct sum of subspaces, Linear combination, Linear span, Linear dependence and independence of vectors and its properties. Basis and dimension of vector space and subspace. Linear mappings, Kernel and Range of linear mapping, Singular and non-singular mappings.

Section B

Linear operator, Algebra of linear operators, Invertible operators, Matrix representation of a linear transformation, Change of basis, Range, rank and Kernel, nullity of a matrix, Elementary transformations, Matrix inversion with elementary transformations, Normal form of a matrix, System of linear equations.

Section C

Characteristics polynomial of a matrix, Characteristics values, Characteristics vector, Cayley-Hamilton theorem, Diagonalization of Matrices, Properties of characteristic values and characteristic vectors of Hermitian, skew-Hermitian, Unitary and Normal matrices (including Symmetric, Skew-symmetric and Orthogonal matrices).

Inner product spaces, Orthogonality, Orthogonal sets and bases, Gram-Schmidt orthogonalization process.

Suggested Books:

1. Axler, S. J. (1996*). Linear algebra done right*. New York: Springer.
2. Krishnamurthy, V., Mainra, V. P., & Arora, J. L. (1976). *An introduction to linear algebra*. New Delhi: East-West Press.
3. Friedberg, S. H., Insel, A. J., Spence, L. E., & Thiel, L. (2017). *Linear algebra*. Pearson Education.
4. Halmos, P. R. (2013). *Linear Algebra Problem Book*. Cambridge: Cambridge University Press.
5. Kumaresan, S. (2000). *Linear Algebra: A Geometric Approach*. New Delhi: Prentice-Hall (India).

Suggested E-Learning Material:

1. Lecture notes on linear Algebra
   https://nptel.ac.in/downloads/111102011/
2. Videos on Linear Algebra topics
   http://web.mit.edu/18.06/www/videos.shtml

PHY 101 Applied Optics

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

Upon successful completion, students will have the knowledge and skills to:

- Appreciate the efficacy of Fourier transforms and their application to physical systems.
- Understand linear, time-invariant systems.
- Understand the role of the wave equation and appreciate the universal nature of wave motion in a range of physical systems
- Understand dispersion in waves and model dispersion using Fourier theory.
- Understand diffraction and imaging in terms of Fourier optics and gain physical and intuitive insight in a range of physics.

Section A

Wave Optics- Interference: Superposition of Waves, Theory and method of measurement of wavelength of light and thickness of a thin transparent plate using Fresnel's Bi-prism, Interference in thin films, Newton's rings, Michelson's Interferometer,

Diffraction I: Fraunhofer's diffraction due to single slit, two parallel slits, and N slits

Section B

Diffraction II: Diffraction by plane transmission grating (PTG), Characteristics of grating spectra, Measurement of wavelength of light using PTG, Concept of resolving power, Rayleigh's criterion of resolving limit, Resolving power of a Grating, Diffraction of X-rays and Bragg's law

Polarization: Production and detection of plane**,** circularly and elliptically polarized light**,** Theory of the polarized light**,** Optical Activity**,** Fresnel's Explanation for optical rotation**,** Measurement of Specific rotation of cane sugar solution using Half Shade and a biquartz device polarimeters,

Section C

Modern Optics- LASER: Spontaneous & Stimulated Emission**,** Einstein's Coefficients**,** Criterion of Laser action**,** Ruby and He-Ne Lasers, Characteristics of Laser light, Applications of Laser with special emphasis on Holography

Optical Fiber: Elementary idea of optical fibers, Light wave communication using optical fibers, Types of optical fibers, Step Index (Single mode and Multi mode) and Graded Index fibers, Light Propagation through optical fiber, Ray optics: Critical angle, Total internal reflection, Acceptance angle, Numerical aperture of an optical fiber;

Recommended Books:

1. Prakash S., Verma A. S., Gupta S. K. and Alvi P. A. (2015) A textbook of Optics and Modern Physics, Pragati Prakashan Meerut.
2. Allen S. R. (1997) An introducton to Fiber Optics, PHI
3. Seth S. P. (2007) Elements of Electromagnetic Field, Dhanpat Rai & Company.
4. Ghatak A. (2005) Optics, Tata McGraw hill publication
5. Beynon (1996) Introductory University optics, Prentice Hall of India Pvt. Ltd.
6. Thyagarajan and Ghatak (1981) Lasers Theory and Applications: Macmillan India Ltd
7. Senior John M. (2005) An introduction to Fiber Optics, PHI
8. Sadiku M. N. O (2007) Elements of Electromagnetics, Oxford University Press.

Suggested e-resources:

https://nptel.ac.in/course.php

PHY 106 Modern Physics

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

Upon successful completion, students will have the knowledge and skills to:

- Development of an understanding of the interrelationships of science, engineering and technology.
- Will have skill for problem solving and engineering skills, which then has broad applications.
- Will have a career paths for Engineering physics are usually (broadly) "engineering, applied science or applied physics through research, teaching or entrepreneurial engineering". This

interdisciplinary knowledge is designed for the continuous innovation occurring with technology.

- Will have strong ground to provide a more thorough grounding in applied physics of any area chosen by the student (such as nanotechnology, mechanical engineering, electrical engineering, control theory, aerodynamics, or solid-state physics).

Sec1tion A

Special Theory of Relativity : Inertial and Non-inertial frames of reference, Postulates of Special theory of relativity, Lorentz Transformation, Relativity of mass, length, time and velocity, mass-energy relation, energy–momentum relation; Wave-Mechanics : Compton effect as evidence of quantum nature of radiation, Heisenberg‘s uncertainty principle, Time dependent and time independent (Steady State) form of the Schrodinger equation, Solutions of Schrodinger equation for a free particle in a one dimensional box and Potential step.

Section B

Free-electron model of metals Origin of Bands in solids (Kronig-Penny model), E-k diagram, Classification of Solids as Metal, Semiconductors and Insulators, Density of energy states and Fermi energy, Crystal structure of Si, Ge and GaAs, Electrical resistivity of Semiconductors, Superconductivity: Introduction, Types of Superconductors, Properties of Superconductors, Meisner Effect, Josephson Effect, BCS theory of Superconductivity (No Derivation) only qualitative discussion, High Temperature Superconductors, Applications of Superconductors.

Section C

Dielectric Materials: Dielectric Constant, Type of Dielectrics, Polarization of Dielectrics, Polarization density, Relation between dielectric constant and electric susceptibility, Types of Polarization (Electronic polarization, ionic polarization, orientation polarization) ,Clausius-Mosotti Equation,

Nuclear Physics: Nuclear Binding Energy, Fission and Fusion Reactions, Construction, theory and applications of Geiger Muller Counter , Proportional and Scintillation Counter.

Recommended Books:

1. Beiser, A. (2003). Concepts of modern physics. Tata McGraw-Hill Education.
2. Krane, K. S. (1995). Modern physics. Modern Physics, 2nd Edition, by Kenneth S. Krane,. ISBN 0-471-82872-6. Wiley-VCH, August 1995.,

3. Birkhoff, G. D., & Langer, R. E. (1923). Relativity and modern physics. Harvard University Press.
4. Leighton, R. B., & Leighton, R. B. (1959). Principles of modern physics (Vol. 795). New York: McGraw-Hill.
5. Prakash S., Verma A. S., Gupta S. K. and Alvi P. A. (2015) A textbook of Optics and Modern Physics, Pragati Prakashan Meerut
6. Raghuvanshi (2008) Engineering Physics, Tata Mc Hill

Suggested e-resources:

https://nptel.ac.in/course.php

CHEM 101 Chemistry

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcome:

On completion of course, the students will be able to:

- explain the basics of atomic structure and chemical bonding.
- explain the behavior of the system through phase, degree of freedom and component.
- explain the basics of electrochemistry, different type of corrosion and their prevention.
- differentiate nanoscience, nanotechnology, nanochemistry, conventional and non-conventional energy sources and their applications.

Section A

Atomic Structure: Schrodinger wave equation, significance of □ and □^{2}, quantum numbers, radial and angular wave function and probability distribution curves, shapes of *s, p, d* orbitals. Aufbau and Pauli principles, Hund's multiplicity rule, exchange energy, pairing energy, symmetrical distribution of charge, extra stability of half-filled and completely-filled orbitals, effective nuclear charge, shielding effect, Slater's rules for evaluation of shielding constant.

Chemical Bonding: Covalent bond: - resonance, valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shell electron pair repulsion (VSEPR) theory with reference to BF_3, BF_4^-,

NH_3, H_2O, H_3O^+, PCl_5, SF_4, CIF_3, I_3^-, SF_6, IF_7, ICI_2^-, and $POCl_3$; MO theory, sigma, pi and delta molecular orbitals, homonuclear and heteronuclear (CO and NO) diatomic molecules and their ions.

Section B

Electrochemistry: Electric transport in electrolytic solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution, migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its uses and limitations, Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only), applications of conductivity measurement: determination of degree of dissociation, determination of Ka of acids, determination of solubility product of sparingly soluble salt, conductometric titrations.

Phase Rule: Phase, component, degree of freedom or variance; phase diagram of one-component system: -water system, sulphur system, CO_2 system, phase rule for two-component system: - Pb-Ag system and its applications, reduced phase rule, eutectic point.

Corrosion: Definition and its significance, Mechanisms of corrosion: Chemical (Dry) corrosion and Electrochemical (Wet) corrosion, Protection from corrosion: Protective coatings, cathodic protection, sacrificial anode and modification in designs etc.

Section C

Water: Hardness of water, determination of hardness by Clark's test and Complex metric (EDTA) method, degree of hardness, numerical based on hardness and EDTA method, Softening of water by Lime-Soda Method, Permutit (Zeolite) Method and Deionization or Demineralization Method, Boiler troubles their causes, disadvantages and prevention, Formation of solids (Scale and Sludge), Carry over (Priming and Foaming), Corrosion and Caustic Embrittlement, Advanced methods of water starelization, Numerical problems based on Lime-Soda and Zeolite softening methods

Organic Electronic Materials: Including conducting polymers- poly (p-phenylene), polythiophenes, Polyphenylenevinylenes, polypyroles, polyaniline.

Optical Fibers- Introduction, properties, preparation, optical fiber grade glass and uses.

Nano-chemistry- Introduction, Size dependent properties, Synthesis (bottom-up and top-down method) and Applications of nanomaterials, Future prospective of nanomaterials.

Non-conventional Energy: Introduction of solar energy, Application of solar energy, Photovoltaic cell, conversion of solar energy, silicon, bio-fuel and biomass, Superiority of non-conventional source of energy over conventional energy.

Recommended Books:

1. B.R. Puri and L.R. Sharma & K.C. Kalia (2017), *Principles of Inorganic Chemistry*, 33rd Ed.,Vishal Publications.
2. L.R Sharma, M.S Pathania B.R Puri and Navjot Kaur (2018), A Textbook of Physical Chemistry, Vishal Publications.
3. W. U. Malik, G.D.Tuli & R. D. Madan (2010), *Selected Topics in Inorganic Chemistry*, Revised Ed., S. Chand Publications.
4. Gurdeep Raj(2014), Advanced Physical Chemistry, goel publications.
5. J.D. Lee (1998), *Concise Inorganic Chemistry*,5th Ed, Oxford Publications.
6. F. A. Cotton and G. Wilkinson (1994), *Basic Inorganic Chemistry*,3rd Ed., John Wiley **Publications**.
7. P. Bhagchandani (2017), *Inorganic* Chemistry, Sahitya Bhawan Publications.
8. S.S. Dara and S.S.Umare (2004), Textbook of Engineering Chemistry, S. Chand **Publications**.

Suggested E-Learning Material:

1. National Programme on Technology Enhanced Learning
   https://nptel.ac.in
2. Online Chemistry Courses
   https://www.edx.org/learn/chemistry
3. Free Online Education SWAYAM
   https://swayam.gov.in

BIO 101 Biology

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

After successful completion of the course, students should be able to:

- Understand the basic organization and classification of living organisms.
- Describe fundamental cellular functions.

- Learn the basic concept of molecular biology and recombinant DNA technology.

Section A

- Brief idea of origin of life, Viruses (TMV, HIV, Bacteriophages), overview and brief introduction to five kingdom classification, characteristic features of Protista, Plantae and Animalia.
- Morphology and functions of different parts of flowering plants: Root, stem, leaf, major inflorescence (Spike, Raceme, Corymb and Umbel), flower, fruit and seed.
- Brief about the components and functions of different systems of humans.

Section B

- The cell concept, prokaryotic (Bacteria, cell structure) and eukaryotic cell (plant and animal cell). Cell organelles and their functions.
- Brief introduction and significance of carbohydrates, lipids, proteins and enzymes.
- Mendelian inheritance chromosome theory of inheritance, deviations from mendelian ratio (Incomplete dominance, co-dominance, complementary genes, multiple alleles). Linkage and crossing over, sex determination, sex linked inheritance, genetic counseling.

Section C

- Structure and replication of DNA, structure of RNA and brief concept of transcription and translation in prokaryotes and comparison with eukaryotes, Genetic code, Basic concept of recombinant DNA Technology and its applications. Overview of Human Genome Project, Biosafety issues.

Suggested Books:

- Green, N. P. O., Stout, G. W., Taylor, D. J. & Soper, R. (2005). *Biological Sciences*. Cambridge University Press.
- Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Jackson, R.B. (2013). *Campbell Biology*. Pearson Publisher, India.

Suggested E-Learning Material:

- **Structural organization of plants and animals** https://www.emedicalprep.com/study-material/biology/structural-organization-in-plants-and-animals/

- **Morphology, anatomy and functions of different systems of humans:**

  https://www.khanacademy.org/science/high-school-biology/hs-human-body-systems/hs-body-structure-and-homeostasis/a/tissues-organs-organ-systems

- **Basic concept of cell**

  https://biologydictionary.net/cell/

- **Gene-gene interaction** http://www.biologydiscussion.com/genetics/gene-interactions/gene-interactions-allelic-and-non-allelic-cell-biology/38795

- **Human genome project**

  https://www.genome.gov/12011238/an-overview-of-the-human-genome-project/

- **Application of recombinant DNA technology:**

  https://medcraveonline.com/JABB/JABB-01-00013

CHE 102 Thermodynamics

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

After successful completion of the course, students will able to:

- Carryout thermodynamic analysis of real systems.
- Carryout thermodynamic analysis multiphase systems with chemical changes.
- Understand thermodynamic functions and their relationships

Section A

Definition, significance and limitations, Classical versus statistical thermodynamics, definition of thermodynamic terms: system, surroundings etc., types of systems, intensive and extensive properties, state and path functions and their differentials, Euler reciprocity relation and cyclic rule, thermodynamic process, concept of heat and work.

First law of thermodynamics: statement, definition of internal energy and enthalpy, heat capacity-heat capacities at constant volume and pressure and their relationship, Joule's Law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, ΔU & ΔH for the expansion of ideal gases

under isothermal and adiabatic conditions for reversible process, application of first law of thermodynamics in closed systems, zeroth law of thermodynamics and the absolute temperature scale.

Section B

Thermochemistry: Heat of reaction at constant pressure and at constant volume, Hess's law of heat summation and its application, temperature dependence of enthalpy (Kirchhoff's equation), bond dissociation energy and its calculation from thermo-chemical data,

Second law of Thermodynamics: need for the law, different statements of the law, Carnot cycle and its efficiency, Carnot theorem, Heat Engine, Efficiencies, thermodynamic scale of temperature.

Concept of Entropy: Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium, entropy change in ideal gases and mixing of gases.

Section C

Thermodynamic Relations: Maxwell's equations, TdS equations, difference in heat capacities, ratio of heat capacities, energy equations, Joule-Kelvin effect, Clausius-Clapeyron equation.

Third law of Thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibb's and Helmholtz functions: Gibbs-Helmholtz equation, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A &G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, variation of G and A with P, V and T.

Suggested Books:

1. Atkins, P. W., & De, P. J. (2006). Atkins' physical chemistry. Oxford: Oxford University Press.
2. Puri, S., Sharma, R. L., & Pathania M. S. (2004). Principles of physical chemistry. Vishal Publishing Co.
3. Sharma, K. K., & Sharma, L. K. (1977). A textbook of physical chemistry. Vikas Publishing House.
4. P. K. Nag (2009). Basic & applied thermodynamics. Tata McGraw Hill.
5. Van Ness, H. C. (1983). Understanding thermodynamics. Courier Corporation.

6. Van Wylen, G. J., & Sonntag, R. E. (1985). Fundamentals of classical thermodynamics. New York: Wiley.

Suggested E-Learning Material:

https://nptel.ac.in

PHY 109 Engineering Mechanics

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

Upon successful completion, students will have the knowledge and skills to:

- Students will demonstrate proficiency in mathematics and the mathematical concepts needed for a proper understanding of physics.
- Students will show that they have learned concept of Newtonian mechanics and kinematics.
- Students will be capable of oral and written scientific communication, and will prove that they can think critically and work independently.

Understand

Section A

System of forces, Fundamental laws of mechanics, Composition of forces, Free body diagram, Lami's theorem. Moments and couple, Varignon's theorem, condition of equilibrium, Types of support and loading, reaction, Analysis of simple trusses by methods of joints and method of sections. Laws of Coulomb fraction, Ladder, Wedges, Belt friction and rolling, Principle of virtual work and its applications

Section B

Location of centroid and center of gravity, area moment of inertia, mass moment of Inertia Law of machines, Variation of mechanical advantages, efficiency, reversibility of Machine Pulleys, wheel and axle, wheel and differential axle, Transmission of power through belt and rope, Moment of Inertia of Masses - Transfer Formula for Mass Moments of Inertia - Mass moment of inertia of composite bodies.

Section C

Kinematics of Particle: Rectilinear motion, plane curvilinear motion, Projectile motion, constrained motion of connected particles.

Dynamics of Particle and Rigid Body: Newton's law of motion, D'Alembert's principle

Work and Energy: Work, energy (Potential, Kinetic and Spring), Work – Energy relation, Law of conservation of energy, **Impulse and Momentum:** Impulse, momentum, Impulse – Momentum relation, Impact, **Vibration:** Definitions, Concepts - Simple Harmonic motion - free vibrations - Simple and compound pendulums - torsional vibrations.

Recommended Books:

3. Sharma, M. (2009) Engineering Mechanics, CBH.
1. Kumar, D. S. (2009) Engineering Mechanics, Laxmi Publications,.
2. Dubey, N. H. (2015) Engineering Mechanics, Tata Mc-Graw Hill.
4. Sharma (2009) Mechanics, Pearson

Suggested E-Learning Material:

https://nptel.ac.in/course.php

CS 109 Computer Fundamentals and Programming

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course, students will be able to:

- Describe the concepts of computer basics and programming.
- Explain the organization and operations of a computer system.
- Design the combinational and sequential circuits.
- Employ the logical thinking for analyzing problems, designing and implementing algorithmic solutions.
- Employ the skills for the use of the C programming language to implement the real world applications.

Section A

Brief introduction to computer organization, Block diagram, Hardware and software. Introduction to operating System, Concept of Data and Information, Representation of data, bits and bytes, Number System (binary, octal, decimal, hexadecimal), Representation of integers, real numbers, positive and negative numbers, Binary arithmetic, simple concepts and theorems of Boolean algebra. Representation of characters: BCD, ASCII, EBCDIC codes. Programming fundamentals: Program, Steps

in program development, programming language, compilers, interpreters. Algorithms, flowcharts, Control statements sequencing, conditional and unconditional branching and looping.

Section B

Overview of C language- History, structure of a program data types, variables, constants, operators (arithmetic, logical, relational), expressions (arithmetic and logical), assignments, conditional statements, control statements, simple I/O. Single and multi-dimensional arrays, Searching (linear, binary), sorting (bubble, selection) and merging, matrix arithmetic.

Section C

Concept of pointers, pointer expression, pointer v/s arrays, functions, parameter passing (call by value, call by reference), recursion, structure, union and enumerated data types, concept of structured programming.

Suggested Books:

1. Sinha, P. K. (2003). *Computer fundamentals: concepts, systems & applications*. BPB publications.
2. Balagurusamy, E. (2012). *Programming in ANSI C*. Tata McGraw-Hill Education.
3. Kanetkar, Y. P. (2016). *Let us C*. BPB publications.
4. Rajaraman, V., & ADABALA, N. (2014). *Fundamentals of computers*. PHI Learning Pvt. Ltd.

Suggested E-Learning Material:

1. Introduction to Programming in C

   https://nptel.ac.in/courses/106104128/
2. Introduction to Programming in C Specialization

   https://www.coursera.org/specializations/c-programming
3. Sinha, P. K. (2003). Computer fundamentals: concepts, systems & applications. BPB publications.

   https://www.edutechlearners.com/computer-fundamentals-p-k-sinha-free-pdf/

CS 109L Computer Fundamentals and Programming Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**4**	**2**

Learning Outcomes:

After successful completion of the course, students will be able to:

- Perform internal and external DOS commands.
- Implement problems based on expressions containing constants, variables and operators.
- Implement problems based on conditional statements, switch and loops.
- Implement problems based on array, pointers, functions, files and command line arguments.

Lab Exercise

i. Explore DOS & WINDOWS Operating System

ii. Implement Following programs in 'C'

  i. Simple Programs
  ii. Arithmetic Calculation
  iii. Formula Based Calculation
  iv. Conditional Statements

iii. Check odd-even, positive-negative

  i. Calculation of Division, Rank of student
  ii. Menu Driven Programs
  iii. Programs using if and switch statement
  iv. Looping

iv. Sum of digits of number, reverse of number, palindrome checking

  i. Table Generation
  ii. Prime number checking, generation
  iii. Calculation of GCD, LCM
  iv. Sum of various series, Fibonacci series,sin, cos, exp etc.
  v. Pattern Drawing

v. Programming with Arrays

  i. Max, min & Average calculation

ii. Linear Search
iii. Binary Search
iv. Bubble Sort
v. Selection Sort
vi. Insertion Sort
vii. Merging
viii. Number System Conversion
ix. Matrix Manipulation- sum of row, column & diagonal element
x. Display and sum of upper triangular, lower triangular matrix elements
xi. Matrix Arithmetic (Addition, Subtraction, Multiplication)
xii. String Manipulation

vi. Pointers and Functions
i. Use of Functions the previous programs
ii. Use of pointers and function in array and string processing
iii. Recursion-factorial, GCD, Fibonacci, Power, Tower of Hanoi etc.

vii. Structures
i. Operations on Complex number
ii. Record storage, searching, sorting, generating reports
iii. Use of Union

EEE 101 Electrical Engineering

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes

After successful completion of the course, students will be able to:

- Understand the importance of electrical engineering
- Solve complex DC circuits
- Solve& predict the behavior of AC circuit
- Understand different machines along with measurement techniques

- Select appropriate element, device or machines with respect to application

SECTION A

DC Networks: Node Voltage and Mesh Current Analysis; Source Conversion. Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power Transform, Laplace transforms and inverse Laplace transforms: Basic Theorem and Circuit analysis using Laplace transformations, Initial and final value theorem.

SECTION B

Single Phase AC Circuits: EMF Equation, Average, RMS and Effective Values. RLC Series, Parallel and Series, Parallel Circuits, Complex Representation of Impedances. Phasor Diagram, Power and Power Factor.

Three Phase A.C. Circuits: Delta-Star and Star-Delta Transformation, Line & Phase Quantities, 3-Phase Balanced Circuits, Phasor diagram, Measurement of Power in Three Phase Balanced Circuits.

SECTION C

Transformer: Magnetic coupled circuits, Dot convention for coupled circuits, coefficient of coupling, mutual inductance, EMF Equation, Voltage & Current, Relationship and Phasor Diagram of Ideal Transformer.

Introduction to principle of DC Machines, synchronous machines and induction motors.

Suggested Books:

1. Toro, V. D. (1989). *Electrical Engineering Fundamentals* (2nd ed.). PHI Publication.
2. Bobrow, L. S. (1996). *Fundamental of Electrical Engineering*(2nd ed.). Oxford Publication.
3. Nagrath, J. & Kothari, D. P. (2017).*Basic Electrical Engineering*(3rd ed.). India: TMH.
4. Sahdev, S. K. (2015). *Basic Electrical Engineering*. India: Pearson Education India.
5. Chakrabarti, A. K. (2018). *Circuit Theory* (7th ed.). Dhanpat Rai and Co.
6. Alaxender, C. & Sadiku, M. N. O. (2003). *Fundamentals of Electrical circuits.* Oxford University Press.
7. Choudhary, D. R. (2013). *Networks and Systems.* Wiley Eastern Ltd.

8. Hayt, W. H., Kemmerly, J.& Durbin, S. M. (2013). *Engineering Circuit analysis* (8th ed.).Tata Mc-Graw Hill.

9. Valkenburg, M.E.V. (2006). *Network Analysis*. New Delhi: Prentice Hall.

Suggested E-Learning Material:

1. https://nptel.ac.in/courses/108108076/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/
3. https://swayam.gov.in/electrical/c/4/engineering
4. https://swayam.gov.in/courses/4746-july-2018-fundamentals-of-electrical-engineering
5. https://nptel.ac.in/courses/108105053/pdf/L-03(GDR)(ET)%20((EE)NPTEL).pdf
6. https://nptel.ac.in/courses/108105053/pdf/L-04(GDR)(ET)%20((EE)NPTEL).pdf
7. https://nptel.ac.in/courses/108105053/pdf/L-06(GDR)(ET)%20((EE)NPTEL).pdf
8. https://nptel.ac.in/courses/108105053/pdf/L-07(GDR)(ET)%20((EE)NPTEL).pdf
9. https://nptel.ac.in/courses/108105053/pdf/L-08(GDR)(ET)%20((EE)NPTEL).pdf
10. https://nptel.ac.in/courses/108105053/pdf/L-14(NKD)(ET)%20((EE)NPTEL).pdf
11. https://nptel.ac.in/courses/108105053/pdf/L-15(NKD)(ET)%20((EE)NPTEL).pdf
12. https://nptel.ac.in/courses/108105053/pdf/L-17(NKD)(ET)%20((EE)NPTEL).pdf
13. https://nptel.ac.in/courses/108105053/pdf/L23(TB)(ET)%20((EE)NPTEL).pdf
14. https://www.scribd.com/doc/123459017/basic-electrical engineering?campaign=SkimbitLtd&ad_group=725X1342X724adc86fb3fde3cdc1f294ab4f382ea&keyword=660149026&source=hp_affiliate&medium=affiliate

EEE 101L Electrical Engineering Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**4**	**2**

Learning Outcomes:

After successful completion of the course, students will be able to:

- Handle measuring instruments and apparatus
- Identify the various electrical and electronic components as per the ratings
- Verify circuit laws and solve electrical networks
- Analyze the characteristics of semiconductor devices
- Design basic AC & DC circuits

LIST OF EXPERIMENTS

1. Study of electronic components and apparatus.
2. Study ofdigital& analog Multimeter.
3. Study of Cathode Ray Oscilloscope (CRO)
4. Verification of principle of Superposition Theorem with DC.
5. Verification of principle of Thevenin's theorem with DC.
6. Verification of principle of Norton's theorem with DC.
7. Verification of principle of Maximum Power Transfer with DC.
8. Determine the frequency response of current in RL & RC circuit.
9. Determine the frequency response of current in RLC circuit.
10. Study of VI characteristics of PN junction diode.
11. Study ofVI characteristics of Zener diode.
12. Study ofVI characteristics of LED, LDR and Photodiode.
13. Study of VI characteristics of BJT in CE configuration.

ENGG 101L Engineering Drawing and Graphics Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**6**	**3**

Learning Outcomes:

After successful completion of the course, students will be able to:

- Apply the concepts of engineering drawing in their respective field of interest.
- Implement various BIS and ISO concepts of drawing.
- Draw the sectional views of various engineering objects.
- Use engineering curves in tracing the paths of simple machine components.
- Draw various views related to real objects.
- Draw and read plan of industrial standards.
- Visualize the design ideas using software.

Indian Standard –Drawing Instruments, Lines & Lines symbols; Sheet Layout of rules of printing; Line sections & Conventions, Lettering, Scales, Curved used in Engineering Practice, Projection of Points, Projection of Lines, Projection of Planes, Projection of Solids, Orthographic Projections, Sectional Views, Rivets & Riveting Joints, Threads, Foundation Bolts & Nuts.

Computer Aided Drawing using Auto CAD /MICRO STATION.

Text Books:

1. Gill,P. S. (2010).*Engineering Drawing*. Kataria Publication,.
2. Bhatt,N. D. & Panchal, V.M. (2011). *Geometrical and Machine Drawing* (19th ed.). Charotar Publication.

e-Resources:-

1. https://nptel.ac.in/courses/112103019/
2. http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html
3. https://ocw.mit.edu/courses/mechanical-engineering/2-007-design-and-manufacturing-i-spring- 2009/related-resources/drawing_and_sketching/
4. https://nptel.ac.in/courses/112104172/

LIST OF EXPERIMENTS

1. Drawing sheet related to lettering.
2. Drawing sheet related to scale.
3. Drawing sheets related to conic sections.
4. Drawing sheets related to Engineering Curves.
5. Drawing sheet related to Projection of points.
6. Drawing sheet related to Projection of lines.
7. Drawing sheet related to orthographic projection by 1st angle.
8. Drawing sheet related to orthographic projection by 3rd angle.

ENGG 103L Measurement Techniques Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**6**	**3**

Learning Outcomes:

After successful completion of the course, students should be able to:

- Demonstrate an understanding of different adulteration and qualitative analysis of biomolecules.
- Develop understanding working with microscope.
- Learn a basic concept of plant identification and vegetational analysis.
- Gain hand on training to check purity of biomolecules.

Biology

1. To test for adulteration in turmeric, wheat flour, ghee and milk.
2. Qualitative analysis of nitrate, carbonate and replaceable base deficiency in soil samples.
3. Determination of soil pH.
4. Biochemical test for sugar, albumin and ketone bodies in urine samples.
5. Biochemical tests for lipids and cholesterol.
6. Detection of Vitamin A in the given sample.
7. Study of typical prokaryotic and eukaryotic cells with the help of a microscope.
8. Gram staining to identify gram positive and gram negative bacteria

9. Description of plant identification (Neem, Babool, Peeli Kaner, Tulsi & Chandani, Aak/ Madar).
10. Vegetational analysis by Quadrat method.
11. Determination of concentration and purity of DNA.
12. Determination of concentration and purity of RNA.
13. Preparation of stained temporary mount of onion peel.

Suggested Books:

- Biradar, V.K., & Samshe, A. (2016). *Practical Biochemistry*. New Delhi: APH Publishing Corporation.
- Sharma, S., & Sharma, R. (2016). *Practical Manual of Biochemistry* (2nd ed.). New Delhi: Medtech.
- Vats, S. (2015). *A laboratory Text book of Biochemistry, Molecular Biology and Microbiology*. Germany: GRIN Verlag.
- Yadav, V.K., & Yadav, N. (2018). *Biochemistry & Biotechnology: A Laboratory Manual*. Jaipur: Pointer Publisher.

MATH 209 Complex Variables

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

After successful completion of the course, students will be able to:

- Demonstrate understanding of the basic concepts underlying complex variables.
- Explain the essential concepts of complex functions and their role in today's mathematics and applied contexts.
- Demonstrate precise and proficient use of complex functions continuity, differentiability.
- Demonstrate capacity for mathematical reasoning through analyzing analytic functions.
- Apply problem-solving using complex analysis techniques applied to diverse situations in physics, engineering and other mathematical contexts.

Section A

Complex functions; Exponential function, Trigomometric and hyperbolic function, Polar form, branch cuts.Continuity, Differentiability, Analytic function, Cauchy-Riemann equations, Harmonic functions.

Section B

Conformal map, Bilinear Transformation, Line integral in complex plane, Cauchy's Integral theorem, Cauchy's integral formula, Derivative of analytic functions, Power series, Taylor's series, Laurent series,

Section C

Singularities, Residue, Residue theorem and Evaluation of real integrals.

Fourier series, half-range expansions, Fourier integrals, Fourier transforms: Fourier sine and cosine transform, Inverse Fourier transforms.

Suggested Books:

1. Kasana, H. S. (2005).*Complex Variables: Theory and Applications* (2nd ed.). India, Delhi:PHI Learning Pvt. Ltd.
2. Ramana, B.V. (2015), *Higher Engineering Mathematics* (25th ed.).India, Delhi: Tata McGraw Hill Co. Ltd.
3. Kreyszig, E. (2011). *Advanced Engineering Mathematics* (9^{th}ed.). Hoboken, NJ : John Wiley & Sons, Inc.

Suggested E-Learning Material:

1. Complex Analysis

   https://nptel.ac.in/courses/111103070/

MATH 210 Differential Equations

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

After successful completion of the course, students will be able to:

- Identify, analyse and subsequently solve physical situation's whose behaviour can be described by ordinary differential equations.
- Solve systems of linear differential equations.
- Solve and interpret first order differential equations arising in problems related to newtonian mechanics, heat conduction, and fluid mixing.
- Apply partial differential techniques to solve the engineering problems.

Section A

Ordinary differential equation of the 1st order and 1st degree; Ordinary linear differential equation of nth order- homogeneous and non-homogeneous with constant coefficient; Euler Cauchy differential equations, Variation of parameters, Methods of undetermined coefficients, System of linear differential equations.

Section B

Power series solutions of ordinary differential equations, Frobenius Method, Legendre equation and Legendre polynomials, Bessel equations and Bessel functions of first and second kind.

Laplace transform and its properties; Convolutions, Inverse Laplace transform, application of Laplace transform for solving ordinary differential equations.

Section C

Partial differential equations of first order, homogeneous and non-homogeneous linear partial differential equations with constant coefficients, Classification of second order Partial differential equations; Solution of one dimensional wave and heat equation, solution of Laplace equation

Suggested Books:

1. Ramana, B.V. (2017). *Higher engineering mathematics*. Mc Graw Hill.
2. Kreyszig, E. (2005). *Advance engineering mathematics.* Wiley Eastern.
3. Zill, D.G. (2013). A first course in differential equation with modeling application. Cengage Learning.

Suggested E-Learning Material:

1. Differential Equations for Engineers
   https://nptel.ac.in/courses/111106100/
2. Differential Equations
   https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/
3. Differential Equations
   https://freevideolectures.com/course/3302/differential-equations-i
4. Differential Equations
   https://www.khanacademy.org/math/differential-equations

ENGG 201 Structure and Properties of Materials

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes::

The students will be able to:

- Relate fundamentals of material properties with its utilization
- Design and develop better products and equipment
- Identify needs and applications of materials economically.

Section A

Atomic bonding in solids: covalent ionic & Van der Waal bonding; Metallic structures: unit cells, crystal systems, crystallographic directions and Miller-Bravais indices, linear and planar densities, close-packed crystal structures; Polymer structure: molecular weight, molecular configurations of polymer; Defects and dislocations: vacancies and interstitials dislocations, grain boundaries; Mechanical test behaviour of metals: elastic and plastic deformation; Chemical properties: corrosion.

Section B

Deformation mechanisms: slip system, plastic deformation, strengthening mechanisms; Diffusion; Phase diagram: phases, micro structure, phase equilibrium, Iron-carbon system: Fe-Fe3C phase diagram, development of microstructure in Fe-C alloys, mechanical behaviour of Fe-C alloy, Tempered Martensite; Kinetics of phase transformations: Avrami rate equation, correlation of properties to microstructure, isothermal transformation diagram, continuous cooling transformation.

Section C

Dielectric materials: polarisation phenomenon, spontaneous polarisation, dielectric constant and loss, piezo and ferro electricity; Magnetic materials: dia, para, ferroand ferrimagnetism; soft and hard magnetic materials and their applications; Conductive materials: electrical properties of conductive and resistive materials, important characteristics and electronic applications of specific conductive & resistive materials; Semiconductor materials: crystal growth, zone refining, degenerated and non-degenerated semiconductors, direct and indirect band-gap semiconductors.

Suggested Books:

1. Callister, W. D., & Rethwisch, D. G. (2018). Materials science and engineering: An introduction.

2. Shackelford, J. F. (2014). Introduction to materials science for engineers. Pearson.
3. Viswanathan B. (2006). Structure and properties of solid state materials. Alpha Science Intl. Ltd .
4. Budinski, K. G., & Budinski, M. K. (2016). Engineering materials: Properties and selection. New Delhi: Pearson India Education.

Suggested E-Learning Material:

https://nptel.ac.in

ENGG 202 Basic Electronics

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

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

- Understand the fundamental of semiconductors and design semiconductor circuits.
- Understand the different type of diode/ transistors with their responses.
- Analyze various types of oscillators available with their utilization.

Section A

Electronics component- Active & Passive components, Types of resistors, inductors & capacitors, Recapitulation of semiconductor, Intrinsic and Extrinsic Semiconductor, Charge density of semiconductors generation and recombination of charges, diffusion, the continuity equation, Injected minority carrier charges, potential variation with in a graded semiconductor, Potential variation in step graded junction, PN Junction diode, current components, volt Ampere characteristic-temperature dependency, space charge & diffusion capacitance, switching time

Section B

Breakdown diode, Tunnel diode, LED, Photo diode, load line, clipping, clamping. The junction Transistor, current, components, configuration - CB, CE, CC, Typical junction values, Ebers-Moll model, photo transistor, analysis of transistor amplifier using h parameter Transistor Hybrid Model,

Emitter follower, Darlington pair, Miller theorem & its Dual, cascading amplifier

Section C

Biasing and stabilization - Static & Dynamic, Bias stability, load line, Need of stabilization, self-bias, fixed bias, emitter bias, feedback bias, Transistor as an Inverter, brief introduction of different coupling techniques

FET- Pinch off, V-I characteristics, MOSFET- Depletion & Enhancement type, Oscillators- Barkhausen criterion, phase shift oscillator, General form of oscillator circuit - Colpitts, Hartley, Wein bridge, crystal oscillator

Suggested Books:

1. Millman. J, Halkias. C, Parikh. C. (2017). *Integrated Electronics. (2/e).* New Delhi: TMH Publications.

2. Boylestad.R. (2012). *Electronic Devices& Circuits Theory.(6/e).* New Delhi: Pearson Publications.

3. Somanathan B. Nair. (2006). *Electronics Devices and Applications.* New Delhi: Prentice Hall India Learning Private Limited

4. Smith. S.(2008). *Microelectronics Circuits. (5/e).* New Delhi: Oxford press, India.

5. Streetman Ben. G. (2006). *Solid State Electronic Devices (6/e)*. New Delhi: PHI Publications.

Suggested E-Learning Material:

1. **Basic Electronics** by Prof. Pramod Agarwal, Department of Electrical Engineering, Indian Institute of Technology, Roorkee. https://nptel.ac.in/courses/117107095/4

2. **Circuits and Electronics** by Anant Agarwal, Massachusetts Institute of Technology: MIT OpenCourseWare. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/6002_l16.pdf

MATH 211 Introduction to Discrete Mathematics

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Solve counting problems involving the multiplication rule, permutations, and combinations (with and without replacement).
- Demonstrate an understanding of relations and functions and be able to determine their properties.
- Describe concepts of Partial Order Set (POSET), Lattice and able to draw Hasse diagram for a POSET.
- Use Prim's or Kruskal's algorithm to construct a minimum spanning tree for a weighted graph.
- Describe concept of generating functions and be able to derive a generating function for a given sequence and derive a sequence from a given generating function.

Section A

Permutations, Combinations, selection with & without replacement, sets and multisets, permutation and combinations of multisets, enumeration of permutations and combination of sets & multisets, Discrete probability, The rules of sum & product, generation of permutation and combinations. Relations and functions, equivalence relations, partial order relations, chains and antichains, lattices and Boolean algebra.

Section B

Basic concepts of graph theory: vertices, edges, degree, paths, circuits, cycles, complete graphs and trees, Multi-graphs and directed graphs, Connected and disconnected graphs, Vertex connectivity and edge connectivity of graphs, weighted graphs, Shortest path in weighted graphs, Eulerian path and circuits, Hamiltonian path and circuits, Planar graphs, Vertex coloring and edge coloring of graphs, Vizing's theorem, Trees, spanning tree and cut set, minimum spanning tree, Adjacency matrix of a graph.

Section C

Pigeon hole Principle: Inclusion-Exclusion principle, Generating functions and Discrete numeric functions, manipulation of numeric functions, Asymptotic behavior of numeric function, Recurrence relations, Linear recurrence relation with constant coefficients and their solutions, Homogeneous solution, particular solution & total solutions, Solution by the method of generating functions.

Suggested Books:

1. Rosen, K.H. (1999). *Discrete Mathematics and it's Applications.* McGraw Hil.
2. Liu, C.L. & Mohapatra, D. P. (2008). *Elements of Discrete Mathematics*, Tata McGraw Hill.
3. Deo, N. (2004). *Graph Theory*. Prentice Hall of India, New Delhi.
4. Biggs, N.L. (1985). *Discrete Mathematics*. Oxford Science Publication.
5. Koshy, T. (2005). *Discrete Mathematics with Applications*. Academic Press.

Suggested E-Learning Material:

1. Rosen, K. H. (2011). *Discrete mathematics and its applications*. New York: McGraw-Hill.
   https://mathcs.clarku.edu/~djoyce/ma114/Rosen6E.pdf
2. Discrete Mathematical Structures
   https://nptel.ac.in/courses/106106094/

CS 207 Computer Organization and Architecture

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course, students will be able to:

- Use the concepts and design of all type of sequential and combinational circuits.
- Have knowledge to design and conduct experiments, as well as to analyze of the hardware of a computer system and its components such as control unit, arithmetic and logical (ALU) unit, input/output, and memory unit.

- Design techniques such as pipelining and microprogramming in the design of the central processing unit of a computer system.

Section A

Review of Number Systems, Binary arithmetic & codes. Logic Gates: Logic Gates and Simplification of Boolean Algebra functions by Map methods, minimal function and their properties, Combinational Circuits design. Adder, subtractor, decoder, demultiplexer, encoder, multiplexer, comparator, three state devices, exclusive-OR gates and parity circuits. Latches and flip flop, synchronous sequential circuits, clocked synchronous state machine analysis and design, asynchronous and synchronous counters, state reduction and assignment, design procedure and design of counter, shift register.

Section B

Instruction codes, Instruction formats, Instruction set, Instruction cycle.Micro programmed Control: Control memory, Address sequencing, Design of control unit.

Central Processing Unit: Stack organization, Addressing modes, data transfer and manipulations, program control CISC& RISC characteristics.

Pipeline and Vector Processing: Parallel processing, pipelining, Arithmetic pipelining, RISC pipeline.

Section C

Memory Organization: memory technology, memory device characteristics, serial access memory. Semiconductor memory - RAM, ROM.Memory hierarchy, Associative memory, cache memory - features, address mapping, cache performance,cache coherence, virtualmemory.

Input - Output Organization, programmed I/O, DMA, Interrupts, I/O Processor. Multiprocessor: Characteristics, Interconnection Structures, Inter processor communication and synchronization.

Suggested Books:

1. Mano, M. M. (2017). *Digital logic and computer design*. Pearson Education India.
2. Mano, M. M. (2003). *Computer system architecture*. Prentice-Hall of India.
3. Hayes, J. P. (1988). *Computer Architecture and Organization.* McGraw Hill.
4. Short, K. L. (1987). *Microprocessors and programmed logic*. Prentice-Hall, Inc.

5. Hennessy, J. L., & Patterson, D. A. (2011). *Computer architecture: a quantitative approach*. Elsevier.
6. Stone, H. S. (1992). *High-performance computer architecture*. Addison-Wesley Longman Publishing Co., Inc.

Suggested E-Learning Material:

1. Stallings, W. (2003). *Computer organization and architecture: designing for performance*. Pearson Education India.
   http://williamstallings.com/ComputerOrganization/
2. The Computing Technology Inside Your Smartphone
   https://www.edx.org/course/computing-technology-inside-smartphone-cornellx-engri1210x-0
3. Computer Organizations and Architecture
   https://nptel.ac.in/courses/106103068/

CS 209 Data Structures

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course, students will be able to:

- Develop knowledge of basic data structures for storage and retrieval of ordered or unordered data. Data structures include: arrays, linked lists, stacks, queues, binary trees, heaps.
- Develop knowledge of applications of data structures including the ability to implement algorithms for the creation, insertion, deletion, searching, and sorting of each data structure.
- Analyze and compare algorithms for efficiency using Big-O notation.
- Describe the concept of dynamic memory management, data types, algorithms, Big O notation.
- Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data.

Section A

Concept of data types, Abstract data type, Data structures, running time of a program, asymptotic notations: Big-Oh, Theta, Little-oh, Omega. Linear data structures: Static implementation of stack, queue, and their applications

Searching and Sorting: Linear search and Binary Search, Bubble sort, Selection sort, Insertion sort, Quick sort, Radix sort.

Section B

Linked List: Linear, doubly or two way, circular, header and various operations; Representation of polynomial using linked list, addition and subtraction of polynomials. Dynamic implementation of stacks and queues. Dynamic memory management: fixed and variable block storage, storage techniques: first-fit, best-fit, worst-fit, next-fit; data compaction, and garbage collection.

Section C

Non linear data structures: Tree concepts, General Tree, binary tree and types, binary search tree, implementation of various operations on Binary Search Tree (tree traversal, searching, insertion and deletion, counting leaf and non-leaf nodes, height), Heap and heap sort, Balanced tree: concepts, rotations, insertion and deletion.

Suggested Books:

1. Langsam, Y., Augenstein, M., & Tenenbaum, A. M. (1996). *Data Structures using C and C++*. New Jersey: Prentice Hall.
2. Tremblay, J. P., & Sorenson, P. G. (1976). *An introduction to data structures with applications.* New York: McGraw-Hill.
3. Horowitz, E., Sahni, S., & Anderson-Freed, S. (2008). *Fundamentals of data structures in C.*Universities Press: Computer Science.
4. Aho, A. V., Hopcroft, J. E., & Ullman, J. D. (1983). *Data Structures and algorithms.* Addison Wesley Publishing Company.

Suggested E-Learning Material:

1. Programming and Data Structures
   https://swayam.gov.in/course/1407-programming-and-data-structures
2. Data Structures and Program Methodology
   https://nptel.ac.in/courses/106103069/

CS 209L Data Structures Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**4**	**2**

Learning Outcomes:

After successful completion of the course students will be able to

- Implement problems based on basic data structures like stack and queues.
- Implement problems on linked lists.
- Implement problems for performing different operations like insertion, deletion and searching on binary tree and binary search tree.

Lab Number	**Problems**
L1-L4	Implementation of stack, Applications of stacks (parenthesis checker, postfix evaluation, infix to postfix), recursion
L5-L7	Implementation of linear, circular, circular queue, priority queue
L8-L12	Implementation of linear link list (creation, traversal, insertion, deletion, searching, sorting, merging, reverse)
L13-L14	Implementation of circular link list (creation, traversal, insertion, deletion, searching, sorting)
L15-L16	Implementation of doubly link list (creation, traversal, insertion, deletion, searching, sorting)
L17	Linked representation of stack and queue
L18	Polynomial arithmetic (Addition, Subtraction)
L19-L30	Implementation of binary search tree (creation, traversal, insertion, deletion,searching), Non recursive traversal (inorder, preorder, postorder)

CS 212 Database Management System

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- List and explain the fundamental concepts of a relational database system.
- Analyze database requirements and develop the logical design of the database using data modeling concepts such as entity-relationship diagrams and normalization.
- Create relational databases in Oracle and implement simple and moderately advanced database queries using Structured Query Language (SQL
- Describe the concept of a database transaction and its desirable properties, concurrency control, locking protocols and deadlock handling.
- Explain the significance of data independence, integrity, security, recovery and performance with reference to a database system.

Section A

Database Management System- Introduction to Database Systems, Comparison between traditional file system and DBMS, Database Users, Role of DBA, Architecture of DBMS. Data models, schema, instances, three level architecture of DBMS, Data Independence, Data modeling using ER and EER diagrams, Reducing ER-diagrams to tables

Section B

Relational Database- Concepts, Constraints. Relational algebra: Selection, Projection, Union, Difference, Cartesian-product, Division. Database Design: Functional dependencies, Normal forms: First, Second, Third, BCNF, Multi-valued dependencies, Fourth normal forms, Join dependencies, and Fifth normal forms.SQL: DDL and DML commands.

Data Integrity, security and authentication in database. Query optimization

Section C

Transaction Processing: Transaction, ACID properties, Serializability, Concurrency control techniques, Lock types (exclusive, shared, update, Intent & Phase Locking), Deadlocks, Management of deadlock. Recovery Techniques.

Distributed Databases: Introduction, Network Topology, Architecture, Transparency, Data fragmentation, Transaction Management, Deadlocks, Homogeneous vs Heterogeneous system.

Suggested Books:

1. Elmasri, R., & Navathe, S. B. (2011). *Fundamentals of Database Systems*. Boston, MA: Pearson Education.
2. Bayross, I. (2000). *SQL, PL/SQL The Programming Language of Oracle*. BPB Publication.
3. Silberschatz, A., Korth, H. F., & Sudarshan, S. (1997). *Database system concepts*. New York: McGraw-Hill.
4. Leon, A. & Leon, M. *Database Management Systems*. McGraw-Hill.

Suggested E-Learning Material:

1. Data Base Management System

https://nptel.ac.in/courses/106105175/

2. Database Management Essentials

https://www.coursera.org/learn/database-management

3. Silberschatz, A., Korth, H. F., & Sudarshan, S. (1997). *Database system concepts*. New York: McGraw-Hill.

https://kakeboksen.td.org.uit.no/Database%20System%20Concepts%206th%20edition.pdf

CS 212L Database Management System Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**4**	**2**

Learning Outcomes:

After successful completion of the course students will be able to

- Create and manipulate structure of tables in Oracle.
- Perform basic operations like insertion, update, and deletion on tables of a database.
- Write complex queries for retrieval of data from more than one table.
- Implement problems in PL/SQL.

Lab Number	**Problems**
L1-L3	Look and feel of DBMS (ORACLE/SQL Server)

L4-L5	DDL commands (Create, Alter, Drop)
L6-L9	DML Commands (Insert, Update, Delete)
L10-L15	SQL (basic constructs)
L16-L18	Operators (Arithmetic, Logical, Relational etc)
L19-L21	SQL (Aggregate functions, set membership functions, set operators)
L22-L30	Nested Sub queries, Assignment based on DDL, DML with conditions. Joins (Self join, inner join, outer join, equi join), Complex queries (Retrieval of data from more than one table)

CS 313 Software Engineering

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Have foundation in mathematics, science, statistics and management skills.
- Illustrate development cycle including feasibility study for planning, analysis, design, implementation and testing phases. Implementations are taught to make them realize the importance of this aspect as well.
- Deal with existing software product and the new product developments. They understand the need for team work environment.
- Apply basic software quality assurance practices to ensure that software designs, development, and maintenance meet or exceed applicable standards. Also, students will have good oral and written communications so that their professionalism will show a mark to the society.

Section A

Software engineering concepts, software evolution, software process models, software project planning: identifying software scope, resources, risk management, project scheduling, tracking, cost estimation: project metrics, cost factors, cost estimation techniques (decomposition, empirical, automated estimation, Delphi). Analysis concepts, structured vs object oriented analysis, object oriented analysis modelling.

Section B

System Design: design concepts and principles (modularization, abstraction, refinement, cohesion, and coupling), object oriented concepts: class and object definitions, encapsulation, polymorphism, inheritance, association, multiplicity, composition and aggregation, generalization, specialization. Object Oriented Modelling using Unified Modelling Language (UML): class diagrams, use case diagrams, sequence diagrams, activity, and state diagrams. Implementation: language classes, coding style, efficiency.

Section C

Software Quality Assurance: quality factors and criteria, SQA metrics, SQA techniques. Verification and Validation: software testing methods (WBT, BBT), software testing strategy (unit testing, integration testing, system, testing), Maintenance: types of maintenance, software maintenance process, maintainability, software reuse, re-engineering, reverse engineering, CASE.

Suggested Books:

1. Pressman, R. S. (2005). *Software engineering: a practitioner's approach*. Palgrave Macmillan.
2. Jalote, P. (2012). *An integrated approach to software engineering*. Springer Science & Business Media.
3. Godbole, N. S. (2004). *Software quality assurance: Principles and practice*. Narosa Publications.
4. Sommerville, I. (2011). *Software engineering*. Boston: Pearson.
5. Fairley, R. (1985). *Software engineering concepts*. McGraw-Hill, Inc.
6. Offutt, J., & Ammann, P. (2008). *Introduction to software testing*. Cambridge: Cambridge University Press.

Suggested E-Learning Material:

1. Software Engineering
   https://nptel.ac.in/courses/106101061/
2. Pressman, R. S. (2005). Software engineering: a practitioner's approach. Palgrave Macmillan.
   http://qiau.ac.ir/teacher/files/911610/13-11-1387-17-31-03.pdf

CS 213 Design and Analysis of Algorithms

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Analyze the performance of various algorithms in terms of time and space.
- Solve recurrence relation using various methods
- Describe the concept and design algorithm using data structures including threaded binary tree, B-Tree and hashing techniques.
- Design numerous algorithm techniques including divide & conquer, greedy, dynamic programming, backtracking and branch & bound.

Section A

Analysis of an algorithm, Time and Space complexity, Asymptotic notation to represent complexity of an algorithm, Solving Recurrence relation by substitution method and master theorem

Advanced Data Structures: Threaded Tree, B-Tree, Union and Find operations on Disjoint Set, Hashing and collision resolution techniques,

Section B

Divide and Conquer: General Method,Max-Min, Merge Sort, Quick Sort, and Matrix Multiplication.

Graph: Representation, Breadth First and Depth First Traversals of Graphs, Connected Components.

Greedy Technique: General Method, Knapsack Problem, Job Sequencing with Deadlines, Optimal Merge Patterns, Minimum Cost Spanning Tree (Prim's and Kruskal's Method), Single Source Shortest Path.

Section C

Dynamic Programming: General Method, All Pair Shortest Paths, 0/1 Knapsack Problem, Traveling Salesman Problem.

Backtracking: General Method, N Queen Problem, Sum of Subsets Problem, Graph Coloring Problem, Hamiltonian Cycles, 0/1 Knapsack Problem.

Branch and Bound: General Method, 0/1 Knapsack Problem, Traveling Salesman Problem.

Suggested Books:

1. Horowitz, E., Sahni, S., & Rajsekran S. (2003). *Fundamentals of Computer Algorithms.*Orient Black Swan.
2. Aho, A. V., Hopcroft J. E., & Ullman J. D. (2016). *The Design and Analysis of Computer Algorithms.* Addison Wesley.
3. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). *Introduction to algorithms*. MIT press.
4. Berlioux, P., & Bizard, P. *Algorithms - The Construction, Proof and Analysis of Programs*. Wiley.
5. Mehlhorn, K. (2013). *Data structures and algorithms Vol. 1 & Vol. 2*. Springer Science & Business Media.

Suggested E-Learning Material:

1. Design and Analysis of Algorithms
   https://nptel.ac.in/courses/106101060/
2. Algorithms Specialization
   https://www.coursera.org/specializations/algorithms
3. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). *Introduction to algorithms*. MIT press.
   https://mcdtu.files.wordpress.com/2017/03/introduction-to-algorithms-3rd-edition-sep-2010.pdf

CS 213L Design and Analysis of Algorithms Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**4**	**2**

Learning Outcomes:

After successful completion of the course students will be able to

- Implement problems based on sorting techniques and max heap.
- Perform various operations on threaded binary tree and B-Tree practically.
- Implement graph based problems.
- Implement problems based on deterministic algorithms.

Lab Number **Problems**

L-1 L5 Implementation of Max Heap (Creation, Insertion, Sorting), Operations on Sets (Creation,Union,Weighted Union, Find and Collapsing find)

L6-L8	Implementation of Threaded Binary Search Tree (Creation, Insertion, Traversal, Searching, Find successor and predecessor of a given node)
L9-L11	Implementation of Divide and Conquer Algorithms(Merge-Sort, Quick -Sort and Matrix Multiplications)
L12-L16	Implementation of Greedy Knapsack problem, Job sequencing with Deadline and Minimum spanning tree algorithms (Prims and Kruskal)
L17-L20	Implementation of Single source shortest path Algorithms, DFS and BFS Algorithms.
L21-L25	Implementation of N-Queens, Sum of Subset, Graph Coloring, 0/1 Knapsack Problem and Hamiltonian Cycle

CS 214 Object Oriented Programming

	L	T	P	C
Max. Marks : 100				
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Describe the features of C++ supporting object oriented programming.
- Explain the relative merits of C++ as an object oriented programming language.
- Describe how to apply the major object-oriented concepts to implement object oriented programs in C++, encapsulation, inheritance and polymorphism.
- Apply advanced features of C++ specifically stream I/O, templates and operator overloading
- Apply other features of the C++ language including templates, forms of casting, conversions, and file handling.

Section A

Basic Concept of Object Oriented Programming: Need of OOP, advantage over other programming paradigms, Tokens, Keywords, Identifiers and Constants, Basic Data Types, Control Structures.

Functions: Call by Value, Call by Reference, Function Overloading.

Class & Objects: Concepts of Objects & Classes, declaring multiple objects, array of objects, Friend Functions.

Section B

Constructors and Destructors: Introduction, Default, Parameterized and Copy Constructor, Concept and use of destructors.

Operator Overloading: Overloading Unary Operators, Overloading Binary Operators.

Inheritance: Derived and Base Class, Public, Private, Protected, Multiple and Multilevel Inheritance, Function Overriding.

Pointers: Pointers to Objects, this Pointer, Virtual Functions, Polymorphism.

Section C

Console I/O: Concept of Streams, Hierarchy of Console stream Classes, Unformatted and formatted I/O Operations, Managing Output with Manipulators

Templates: Class and function templates, overloading of function templates

File Handling: Classes for file stream operations, open and close a file, EOF, file modes, file pointers and their manipulators, sequential I/O operations, updating a file-Random access, Error Handling During File Operation.

Suggested Books:

1. Balagurusamy, E. (2001). *Object Oriented Programming with C++, 6e*. Tata McGraw-Hill Education.
2. Schildt, H. (2003). *C++: The complete reference*. McGraw-Hill.
3. Lafore, R. (1997). *Object-oriented programming in C++*. Pearson Education.
4. Stroustrup, B. (2000). *The C++ programming language*. Pearson Education India.
5. Venugopal, K. R. (2013). *Mastering C++*. Tata McGraw-Hill Education.

Suggested E-Learning Material:

1. Stroustrup, B. (2000). *The C++ programming language*. Pearson Education India.
   http://www.stroustrup.com/C++.html
2. Programming in C++
   https://nptel.ac.in/courses/106105151/

CS 214L Object Oriented Programming Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**4**	**2**

Learning Outcomes:

After successful completion of the course students will be able to

- Implement problems based on expressions, arrays and strings.
- Carry out problems using functions, class, constructor and destructor.
- Implement problems using pointers, operator overloading, inheritance, file handling and exception handling.

Lab Number	**Problems**
1-8	Implementation of simple problems with the Objects and class. Understanding of private, public and protected access using problem, Implementation of static variable & static member function. Constructors & destructors. Problems using friend function.
9	Implementation of polymorphism.
10	Implementation of inheritance
11-16	Implementation of operator overloading to overload various operators: unary operators (+, -, *, % etc) and binary operators: +, *, [ ], >> and << operators on vectors
17-18	Problem related with dynamic binding. Problems using this pointer
19-20	Problems related with the templates function and template classes.

CS 216 Systems Programming

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Learn concepts of System Software, IBM 360/370 hardware programming.
- Design, write, and test moderately complicated low-level programs using a systems programming language such as Assembler, Macro processor and loaders.
- Enumerate and explain the function of the common operating system functions and types.
- Learn Working of a compiler and text editor.
- Illustrate MS dos, ROM BIOS and Interrupt system.

Section A

System Software: Components and Evolution.General Machine Structure: Memory, Instructions, Registers. Operating Systems: Types, basic functions, concept of process and lifecycle of process.

Assemblers: Elements of Assembly Language Programming, A Simple Assembly Scheme, Pass Structure of Assemblers, Design of 2 pass assembler.

Section B

Macros and macro processors: Macro Definition and Call, Macro Expansion, Nested Macro Calls, Design of a Macro Preprocessor. Loaders and linkers: Loader schemes (Compile and go loader, general loader scheme, absolute loader, subroutine linkage, relocating loader, direct linking loader, binders and overlays). Software Tools: Editors, Debug Monitors, Program generators, Translators, Interpreters.

Section C

Compiler: Brief description of different phases. ROM BIOS, DOS, keyboard, mouse and display services. Device Drivers: Types, structure and processing. Interrupt: Types, Organization, processing, IVT, interrupt handler.

Suggested Books:

1. Donovan, J. J. (1972). *Systems programming*. New York: McGraw - Hill.

2. Duncan, R. (1988). *Advanced MS-DOS Programming*. Redmond, WA: Microsoft Press.
3. Dhamdhere, D. M. (1986). *Introduction to system software*. Tata McGraw-Hill.
4. Bose, S. K. (1996). *Hardware and Software of Personal Computers*. New Age International.
5. Biggerstaff, T. J. *System Software Tools*. Prentice Hall.
6. Dhamdhere, D. M. (1999). *Systems Programming and Operating Systems*. Tata McGraw-Hill.
7. Norton, D. A. (1992). *Writing Windows device drivers*. Addison-Wesley.

Suggested E-Learning Material:

1. System Programming
   http://solomon.ipv6.club.tw/Course/SP.941/

ECO 307 Fundamentals of Economics

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**0**	**0**	**3**

Learning Outcomes:

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

- Understand various aspects of economics that affects the day today functioning of business.
- Understand the concept of demand, supply and production and how the same is related to market.
- Understand the basic financial concepts that affects the functioning of the business.

Section A

What Economics is all about? Micro and Macro Economics. Origin and meaning of Engineering Economics, Role of Economics in Engineering, Scope of Engineering Economics.

Theory of Demand: Law of Demand, Demand Function and Determinants of Demand, Types of Demand.

Elasticity of Demand: Concept, Types and Measurement.

Section B

Production function and Laws of Production.Optimal Input combination. Cost concepts and cost output relationship.

Types of market structures; Determination of equilibrium price and output under perfect competition.

Section C

Timevalue of Money and Project Evaluation: Interest Formulas; Cash Flow Diagram; Principles of Economic Equivalance, Evaluation of Engineering Projects using methods of Present Value and Internal Rate of Return.

Capital Budgeting: Concept and significance of capital budgeting.

Depreciation Analysis: Meaning and causes of depreciation; methods of calculating depreciation – straightline and declining balance methods.

Recommended Books:

1. Thuesen. G.J., and Fabrycky, *N.Engineering Economy*, (9 ed) PHI Learining Private Limited, New Delhi.
2. S. ParkChan: *Contemporary Engineering Economics:* 3rd Edition, Prentice Hall.
3. M. Parkin: *Economics:* 5th Edition, Addison Wesley.
4. Mahendra P. Agasty: *Engineering Economics and Costing, Second Edition:* Scitech Publications (India) Pvt. Ltd.
5. R. Panneerselvam: *Engineering Economics, Tenth Printing:* PHI Learning Private Limited, New Delhi.

Suggested E-Learning Material:

1. Agrawal, D. (2017, Mar8). Indifference Curve. Retrieved from Youtube:

   https://www.youtube.com/watch?v=31_rYca4eio.
2. econ (2012). Cost, Retrieved from:

   Guide:https://www2,econ.iastate,edu/classes/econ301/jintanakul/Notes/Ch7.pdf
3. Khan, Y. (2014, Dec 18). Production Function. Retrieved from Youtube:

   https://www.youtube.com/watch?v=MwuTt3L2hEQ.
4. Bhogal, S. (2018, June 04). Income and Cross Elasticity. Retrieved from Youtube:

   https://www.youtube.com/watch?v=i7O4CriwwrY.

MGMT 310 Principles of Management

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**0**	**0**	**3**

Learning Outcome:

Upon completion of the course the student will be able to:

- Evaluate the global context for taking managerial actions.
- Understand conflict resolution, motivation and leadership.
- Understand application of theories and management principles.

Section-A

What is management? Scientific approach-Taylor's contribution, administrative approach-Henry Fayol's contribution, human relation approach-Elton Mayo's contribution, system approach.

Planning: Need and process, types of plans-goals, objectives, policies and strategies; decision making-situations and process.

Section-B

Organizing: Organization structure, departmentation, centralization v/s decentralization, span of management, delegation and power of authority. Motivation-importance, theories of motivation-Maslow, McClleland Herzberg, theories.

Section-C

Theories and styles of leadership-Trait, behavioral.

Communication: Process and principles, types of communication, barriers to communication.

Control: Process of evaluation & control, method of control.

Suggested Reading:

1. Tripathi, P. C., & Reddy, P. N. (2017) Principles of Business Management, (22ed.) Tata McGraw Hill, New Delhi
2. Robbins & D. Cenzo. *Fundamentals of Management (10ed)*, New Delhi, Pearson Education Asia
3. Prasad,L.M.*Principles and practice of Management (9ed)* .Sultan Chand & sons, New Delhi

4. Weihrich&Koonts. *Management-A Global Perspective (13ed)*, Tata McGraw Hill, New Delhi

Suggested E-Learning Material:

1. Prachi, J. (2016). *Planning Function of Management*. Retrieved from Management Study Guide: https://www.managementstudyguide. com/planning_function.htm
2. Amit,L. (2018, December). *Controlling: Features,process and types*. Retrieved from: https://www.youtube.com/watch?v=JRVXfaFrMEM
3. Brian, T. (2017, May 11). *Different Types of Leadership Styles*. Retrieved from: https://www.youtube.com/watch?v=vilZazhIjoc
4. Chandan,P (2017, September 26). *Organising:Meaning,Process and Types*. Retrieved from https://www.youtube.com/watch? v=XrmJG_8d9Cg

MATH 311 Numerical Methods

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Analyze and evaluate the accuracy of common numerical methods.
- Solve the nonlinear equations, system of linear equations and interpolation problems using numerical methods with error analysis.
- Examine the appropriate numerical differentiation and integration methods to solve engineering problems.
- Analyze the appropriate numerical method to find the eigen values and corresponding eigenvectors of a system.
- Apply the numerical methods to solve differential equations.

Section A

Errors analysis- Approximations and round off and truncation errors, Root finding for nonlinear equations (transcendental and algebraic equations);

Iterative method, Bisection method, Regula-Falsi method, Newton Raphson's method, Order of convergence, Numerical methods for solving system of linear equation, Ill-conditioning.

Section B

Finite differences, Interpolation, Newton's formula for forward and backward interpolation, Newton's general interpolation formula, Lagrange's interpolation formula, Numerical differentiation.

Section C

Numerical integration; Newton's cotes quadrature formula, Trapezoidal, Simpson's rules. Numerical solution of first and second order differential equations, Euler's method, Picard's method, Runge-Kutta's method.

Suggested Books:

1. Rao, K. S. (2006). *Numerical Methods for Scientists and Engineers* (3rd ed.). PHI learning, India.
2. Ramana, B.V. (2015). *Higher Engineering Mathematics* (25th reprint). McGraw Hill.
3. Kreyszig, E. (2011). *Advanced Engineering Mathematics* (9th ed.). Wiley Eastern.

Suggested E-Learning Material:

1. Introduction to Numerical Analysis for Engineering
   https://ocw.mit.edu/courses/mechanical-engineering/2-993j-introduction-to-numerical-analysis-for-engineering-13-002j-spring-2005/index.htm
2. Numerical Analysis
   https://nptel.ac.in/courses/111107062/
3. Elementary Numerical Analysis
   https://nptel.ac.in/courses/111101003/

STAT 204 Probability and Statistical Methods

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**3**	**1**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Understand the concepts of random variables, probability distributions and independence of random variables.
- Understand the meaning of probability and probabilistic experiment
- Familiarize with the all approaches to probability theory and particularly, the axiomatic approach.
- Understanding the meaning of conditional probability.
- Distinguish between independent and uncorrelated random variables.
- Distinguish between discrete and continuous random variables and be able to represent them using probability mass, probability density, and cumulative distribution function.
- Identify important types of distributions such as exponential, Binomial, Poisson, Normal, and use them as suitable models in basic science and engineering problems.
- Understand the concept of statistical hypothesis and able to solve such type of real life problems.

Section A

Basic concepts of Probability, Classical, Empirical and Axiomatic approach to Probability. Addition and Multiplication theorems of Probability. Baye's theorem and its simple applications. Marginal, Joint and Conditional probability. Mathematical Expectation: Expectation of sum & products of random variables, Variance & Covariance.

Section B

Correlation & Regression Karl Pearson coefficient of Correlation. Partial and Multiple Correlation (upto three variables only).

Probability Distributions: Binomial, Poisson, Normal, Rectangular & Exponential distributions with simple applications. Fitting of Binomial, Poisson, and, Normal distributions.

Section C

Sampling distribution, Standard Error, Simple random sampling and stratified random sampling with their role. Test of significance for mean, variance, Proportion and correlation coefficient. Test of goodness of fit and independence of attributes. Analysis of variance with one observation per cell.

Suggested Books:

1. Johnson, R. A., Miller, I., & Freund, J. E. (2011). *Probability and Statistics for Engineers*, Prentice Hall.
2. Goon, A. M., Gupta, B. D. & M. K. Gupta.(1980). *Fundamental of Statistics*. (Vol. I & II).The World Press Pvt. Ltd. Kolkata.
3. Mood, A. M., Graybill, F. A., &Boes, D. C. (2001). *Introduction to Theory of Statistics* (3rd ed.). McGraw- Hill International.

Suggested E-Learning Material:

1. Probability and Random variables

   https://ocw.mit.edu/courses/mathematics/18-440-probability-and-random-variables-spring-2014/lecture-notes/
2. Probability and Statistics

   https://nptel.ac.in/courses/111105041/27
3. Statistical Inference

   https://nptel.ac.in/courses/111105043/]

CS 304 Java Programming

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Explain Object Oriented Programming & Java Programming Constructs.
- Explain basic concepts of Java such as Operators, Classes, Objects, Interface, Inheritance, Packages, Enumeration and various keywords.
- Apply the concepts of Exception Handling, Collections, Input/output operations, Socket Programming, Database Connectivity in their programs.
- Design the applications of Java, Swing, Applet and JSP.
- Analyze & Design the concept of Event Handling and Abstract Window Toolkit (AWT).

Section A

Java Introduction: Evolution, features, concepts of Java Virtual Machine (JVM) and its task, Java and Internet, Environment (JRE, JDK, JSDK, APIs), Application & Applet.

Java Programming: Structure of program, Data Types, Variables, Operators, Expressions, Control statements (sequencing, alteration, looping), Object oriented Concepts, Objects, Classes, Constructors, Method Overloading, Arrays, String handling, Wrapper classes, packages, Access Specifier, Inheritance, Method Overloading, Interfaces, Inner & Anonymous classes.

Section B

Exception handling, Streams and I/O programming, Serialization, Multithreading, Collection framework (Set, Map, List, Vector), Generic, Iterators, Utility Classes, Networking, Socket and Datagram programming, JDBC, ODBC-JDBC drivers Database Connectivity, JDBC statements, Resultset, Metadata.

Section C

GUI in Java using graphics classes , Features of AWT and Swing, Layout Managers, Event handling, Adapter classes, Applet, Frames, all components of AWT (button, textbox, checkbox, fonts etc).

Java Server Pages (JSP), Servlet, Introduction to J2EE & EJB, Deployment of applications.

Suggested Books:

1. Schildt, H. (2007). *Java: the complete reference*. McGraw-Hill.
2. Rajgopalan, S. *Java Server Programming Bible*. Wiley Publication
3. Balaguruswamy, E. (2014). *Programming with Java-A Primer*. McGraw-Hill Professionals.
4. Ganguli, M. *JSP: A Beginner's Guide*. Wiley Publication
5. Deitel, P. J., & Deitel, H. M. (2014). *Java: How to Program*. Pearson Education Limited.
6. Horstmann, C. S., & Cornell, G. (2002). *Core Java 2: Volume I & Volume II, Fundamentals*. Pearson Education.
7. Bayross, I. (2009*). Web Enabled Commercial Application Development Using HTL, DHTML, Javascript, Peril CGI*. BPB Publications.
8. Haecke, B. V. (1997). *JDBC: Java Database Connectivity*. IDG Books Worldwide, Inc.

Suggested E-Learning Material:

1. Java Lectures

   https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. Object Oriented Programming in Java Specialization

   https://www.coursera.org/specializations/object-oriented-programming

CS 304L Java Programming Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**6**	**3**

Learning Outcomes:

After successful completion of the course students will be able to

- Implement problems based on control statements, classes, inheritance and arrays.
- Implement problems based on packages, interfaces, wrapper classes and exception handling.
- Implement problems on threads, applets, graphics, event handling, swings, networking and Servlets.

Lab Number	**Problems**
L1 – L2	Simple Programs
L3 – L4	Programs based on Control Statements
L5 – L8	Programs based on Classes & Inheritance
L9 – L10	Programs based on Arrays
L11 – L12	Programs based on Packages & Interfaces
L13 – L14	Programs based on Wrapper Classes
L15 – L16	Programs based on Exception Handling
L17 – L18	Programs based on I/ O Classes
L19 – L20	Programs based on Strings
L21 – L23	Programs based on Threads
L24 – L26	Programs based on Applets
L27 – L28	Programs based on Graphics
L29 – L32	Programs based on Event Handling
L33 – L35	Programs based on Swings & GUI Components
L36 – L37	Programs based on Serialization
L38 – L39	Programs based on Networking
L40 – L41	Programs based on JDBC
L42 – L45	Programs based on JSP & Servlets

CS 302 Data Communication and Networks

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Independently understand basic computer network technology and the Data Communications System and its components.
- Describe the layers of the OSI model and TCP/IP and the function(s) of each layer.
- Describe the importance of data communications and the Internet in supporting business communications and daily activity.
- Analyze the features and working of IPV4, IPV6 and their transition with Connection less and Connection oriented Transport layer protocols (TCP/UDP).
- Analyze the features and operations of various protocols such as Http, DNS, SMTP and many more application layer protocols.

Section A

Data Communication Model, tasks of a communication system, computer network, historical background of computer networks, analog and digital transmission, transmission media, signal encoding techniques: digital data digital signals, digital data analog signals (ASK, PSK, FSK), analog data digital signals (PCM, Delta modulation), analog data analog signals (AM, FM, PM), multiplexing (TDM, WDM, FDM).

Section B

Principles and Purpose of layered approach, OSI model, TCP\IP protocol suite, Data link control: framing & synchronization, Error detection & Error correction techniques, Flow control & Error Control protocols (stop and wait, sliding window, go-back-N, selective repeat), MAC layer (CSMA/CD, CSMA/CA), Network switching techniques, Internetworking: various internetworking devices, Routing (unicast routing).

Section C

Internet Protocols (IPv4, IPv6), IP addressing (classless, classful, IPv6). Transport protocols: TCP, UDP, SCTP; Application layer protocols: DNS, FTP, E-mail, HTTP; Network security: overview of cryptography, RSA algorithm, firewalls.

Suggested Books:

1. Tanenbaum, A. S. (2014). *Computer networks*. PHI
2. Stallings, W. (2007). *Data and computer communications*. Pearson Education India.
3. Gupta, P. C. (2013). *Data communications and computer networks*. PHI Learning Pvt. Ltd.
4. Kurose, J. F., & Ross, K. W. (2009). *Computer networking: a top-down approach*.Pearson Education
5. Forouzan, A. B. (2007). *Data communications & networking*. Tata McGraw-Hill Education.

Suggested E-Learning Material:

1. Computer Networking: A Top-Down Approach by James F. Kurose and Keith W. Ross
   https://www.bau.edu.jo/UserPortal/UserProfile/PostsAttach/10617_1870_1.pdf
2. Data Communication by IIT Kharagpur
   https://nptel.ac.in/courses/106105082/

CS 308 Operating Systems

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Learn the fundamentals of Operating Systems.
- Learn the mechanisms of OS to handle processes and threads and their communication.
- Learn the mechanisms involved in memory management in contemporary OS.
- Gain knowledge on Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols.
- Know the components and management aspects of concurrency management with case study of UNIX.

Section A

History of operating systems, OS Functions, OS Goals, OS classification: single user, multiuser, Batch Processing Operating System, Time Sharing, Real Time Operating System (RTOS), Multiprogramming Operating System, Multiprocessing System, Networking Operating System, Distributed Operating System, Operating Systems for Embedded Devices, Introduction to popular operating systems like UNIX, Windows, etc.

Process management: Process status, schedulers, scheduling algorithms, Threads

Inter process communication: Process Synchronization, Critical Section problem and its solutions, classical problems in concurrent programming.

Deadlock: Prevention, Avoidance, Detection and recovery.

Section B

Information Management: Management file supports, access methods, allocation methods, contiguous, linked and indexed allocation, directory system.

Memory management: swapping, paging and segmentation demand paging, virtual memory, page replacement algorithms, working set model.

Secondary storage: Disks, disk space management, Scheduling algorithms.

Input/output: device controllers and device drivers, I/O processor management: I/O scheduler.

Section C

Protection and Security - Accessibility and Capability Lists

Multiprocessor Systems: Bus-oriented System, Crossbar-connected System, Hypercube System, Multistage Switch-based System

Parallel processing and distributed processing: concept, differences, OS.

Case study: Unix (History, Design principles, interface, file system, process management, memory management, I/O management, vi editor, shell.

Suggested Books:

1. Godbole, A. S. (2005). *Operating systems*. Tata McGraw-Hill Education.
2. Silberschatz, A., Gagne, G., & Galvin, P. B. (2018). *Operating system concepts*. Wiley Publications.
3. Tanenbaum, A. S. (2009). *Modern operating system*. Pearson Education, Inc.

4. Kanetkar, Y. P. (1996*). UNIX shell programming*. BPB Pub.
5. Deitel, H. M., Deitel, P. J., & Choffnes, D. R. (2004). *Operating systems*. Delhi.: Pearson Education.

Suggested E-learning Material:

1. Operating Systems
   https://nptel.ac.in/courses/106108101/
2. Linux for Developers
   https://www.coursera.org/learn/linux-for-developers

CS 324L Operating Systems Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**2**	**1**

Learning Outcomes:

After successful completion of the course students will be able to

- Perform various Linux commands.
- Write shell scripts for the various problems using conditional statements and loops.
- Write shell script for the problems based on positional parameters, expressions and basic commands.

Lab Problems:

- Introduction to Unix/Linux
- Working with VI editor
- Commands
  - Man command
  - Files and Directory management (ls. chmod, cat etc.),
  - Zipping and Archiving (zip, gzip, tar etc.).
  - Filter commands (head, tail, grep etc.).
  - I/O redirection commands (>, >>, 2>, < etc.).
  - Miscellaneous (bc, expr, echo, read etc.)
- Shell scripting
  - Introduction to BASH shell.
  - Problems based on conditional statements (if else, switch).
  - Problems based on command line arguments.
  - Problems based on loops (for, while).

CS 315 Theory of Computation

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Model, compare and analyze different computational models using combinatorial methods.
- Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
- Identify limitations of some computational models and possible methods of proving them.
- Have an overview of how the theoretical study in this course is applicable to and engineering application like designing the compilers.

Section A

Mathematical Preliminaries, Alphabets, Strings, Languages, States, Transitions, Finite Automata and Regular Expressions, Applications e.g. Lexical Analyzers and Text Editors, Pumping Lemma, Closure Properties of Regular Sets, Decision Algorithms for Regular Sets.

Section B

Context Free Grammars, Chomsky Normal Forms And Greibach Normal Forms, Ambiguity, Pushdown Automata and the Equivalence of Contex Free Languages to Sets Accepted by Non-Deterministic PDA, Pumping Lemma for CFL's, Closure Properties of CFL's and Decision Algorithms for CFL's.

Section C

Turing Machines: Introduction, Turing Computability, Non-deterministic, Multitape and other versions of Turing Machine, Church's Hypothesis, Primitive Recursive Function, Gödelization, Recursively Enumerable Languages, Undecideability: Universal Turing Machines and Unsolvability of the Halting Problem, Post's Correspondence Problem.

Suggested Books:

1. Hopcroft, J. E., Motwani, R., & Ullman, J. D. (2001). *Introduction to automata theory, languages, and computation*. Narosa Publishing House.

2. Wood, D., & Wood, D. (1987). *Theory of computation*. New York: Harper & Row Publishers.
3. Lewis, H. R., & Papadimitriou, C. H. (1997). *Elements of the Theory of Computation*. Prentice Hall PTR.
4. Martin, J. C. (1991). *Introduction to Languages and the Theory of Computation*. NY, USA: McGraw-Hill.
5. Srimani, P. K., & Nasir, S. F. B. (2007). *A Textbook on Automata Theory*. Cambridge India.

Suggested E-Learning Material:

1. Theory of Computation

   https://nptel.ac.in/courses/106104028/
2. Linz, P. (2006). *An introduction to formal languages and automata*. Jones & Bartlett Learning.

   lhttp://almuhammadi.com/sultan/books/Linz.5ed.pdf

CS 317 Artificial Intelligence and Machine Learning

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Describe the various searching techniques, constraint satisfaction problem and example problems-game playing techniques.
- Apply these techniques in applications which involve perception, reasoning and learning.
- Explain the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.
- Acquire the knowledge of real world Knowledge representation.
- Analyze and design a real world problem for implementation and understand the dynamic behavior of a system.
- Use different machine learning techniques to design AI machine and enveloping applications for real world problems.

Section A

Introduction to Artificial Intelligence, General Problem Solving, State Space and Graph Model techniques, Heuristic Designs, Aim Oriented Heuristic Algorithms Versus Solution Guaranteed Algorithms, Game

Playing Strategies, Knowledge representation tools, First Order Predicate Calculus.

Introduction to Machine Learning, Types of Machine Learning, Data Preprocessing, Importance of features in learning, Feature Selection, Feature Extraction Process.

Section B

Types of Supervised Learning, Difference between Classification and Regression, Understanding Regression: Simple, Multiple and Polynomial, Exploring popular learning algorithms for regression and classification: Support Vector Machine (Regression and Classification), Decision Tree (Regression and Classification), Naïve Bayes (Classification), Evaluation of Classification and Regression Models

Section C

Introduction to Clustering, KMeans, Hierarchical, Introduction to Reinforcement Learning, Upper Confidence Bound, Thompson Sampling.

Model Selection and Boosting, k-fold Cross Validation, XGBoost.

Natural Language Processing, Extraction of features from Text, Tokenization, Understanding Markovian Process for Text Processing. Case Studies.

Suggested Books:

1. Russell, S., & Norvig, P. (2011). *Artificial Intelligence A Modern Approach.* 3rd Edition: Pearson Education.
2. Rich E., Knight K. & Nair S.B. (2011). *Artificial Intelligence 3rd Edition*. Tata McGraw Hill.
3. Mitchell T.M. (1997). *Machine Learnin.*, McGraw Hill International
4. Flach, P. (2012). *Machine learning: the art and science of algorithms that make sense of data*. Cambridge University Press.
5. Mohri, M., Rostamizadeh, A., & Talwalkar, A. (2018). *Foundations of machine learning*. MIT press.
6. Nilsson, N. J., & Nilsson, N. J. (1998). *Artificial intelligence: a new synthesis*. Morgan Kaufmann.
7. Padhy, N. P. (2005). *Artificial intelligence and intelligent systems*. Oxford University Press.
8. Siegel, E. (2013). *Predictive analytics: The power to predict who will click, buy, lie, or die.* John Wiley & Sons.

9. Foreman, J. W. (2013). *Data smart: Using data science to transform information into insight*. John Wiley & Sons.

10. Murphy, K. P. (2012). *Machine learning: a probabilistic perspective*. MIT press.

Suggested E-Learning Material:

1. IBM's Cognitive AI Class
   https://cognitiveclass.ai
2. MIT's Open Courseware on Machine Learning
   https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-867-machine-learning-fall-2006/
3. Scikit Learn Online Documentation
   https://scikitlearn.org/stable/documentation.html

CS 317L Artificial Intelligence and Machine Learning Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**4**	**2**

Learning Outcomes:

After successful completion of the course students will be able to

- Understand problem solving in Python.
- Able to handle different kinds of data processing algorithms.
- Implement supervised and unsupervised machine learning algorithms in Python.
- Able to optimize machine learning algorithms.

Lab No.	**Topics**
Lab 1-2	Introduction to Python, Console, Input, Output, Understanding Control Structures
Lab 3-4	List, Tuples, Strings, file handling
Lab 5-6	Scikit-Learn, Data Preprocessing: Missing Data, Categorical Data, Splitting Data, feature Selection
Lab 7	Regression: Simple, Multiple
Lab 8	Support Vector Regression
Lab 9	Decision Tree Regression
Lab 10	Evaluation of Regression Model

Lab 11	SVM Classification
Lab 12	Decision Tree Classification
Lab 13	Naïve Bayes Classification
Lab 14	Evaluation of Classification Model
Lab 15	KMeans Clustering
Lab 16	Hierarchical Clustering
Lab 17-19	Upper Confidence Bound
Lab 20-21	Thompson Sampling
Lab 22-23	k-fold Cross Validation
Lab 24-25	XGBoost
Lab 26	Extracting Features from Text
Lab 27	Training a NL Classifier
Lab 28	Evaluation of NL Classifier and Parameter Tuning

IT 302 Internet and Web Technology

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Describe the working of Internet & World Wide Web.
- Develop a dynamic webpage by the use of java script, HTML & CSS.
- Write a server side java application called Servlet to catch
- Write a server side java application called JSP to catch form data sent from client, process it and store it on database.
- Develop web application using JSP with database connectivity.

Section A

Introduction: Introduction to Internet, History & Evolution of Internet, Architecture of Internet, Working of Internet, Various services of Internet, Introduction to World Wide Web, Architecture of WWW, Web Browser architecture, working & Features of web browser, Web Documents, type of web documents

HTML: Introduction to HTML, structure of HTML document, Elements (Headings ,Paragraphs ,Formatting , Lists ,Quotations ,Links, Images, Tables , Forms, Audio, Video, Blocks, Layouts etc.) & Attributes

Section B

CSS: Introduction, Syntax of CSS rule, Internal, External and Embedded CSS, CSS properties (Text, Fonts, Tables, Border, Box, background), Class Selector, ID Selector, Element Selector, Pseudo classes.

JavaScript(JS): Introduction to JavaScript, JavaScript basics (statements, syntax, comments, variables, operators, data types, control structures, loops), JS objects, JS functions, JS form API, JS HTML DOM, JS Browser BOM, regular expressions, data validations using JS

XML: Introduction to XML, XML document rules, XML type definition, XML Schemas, XML schema documents, XML programming interfaces

Section C

JSON: Introduction to JSON, JSON syntax, uses of JSON, parsing and generating JSON.

AJAX: Introduction to AJAX, Creating Ajax requests and responses, Monitoring Ajax request state and events, Responding to Ajax requests with HTML and JSON

Server-side Technologies: Historical background of server side technologies, Web Server architecture, accessing web server, working & features of web server, Basics of JSP, JSP implicit objects, JSP Session Tracking, JSP Cookies handling, JSP page redirecting, database connectivity in JSP

Web2.0: Introduction to Rich Internet Application, Introduction to Service oriented Architecture, Introduction to Web Services

Suggested Books:

1. Deitel, P., & Deitel, H. (2007). *Internet &world wide web: how to program*. Prentice Hall Press.
2. Greenlaw, R., & Hepp, E. (2001). *Inline/online: fundamentals of the internet and the world wide web*. McGraw-Hill Higher Education.
3. Pekowsky, L. (2017). *Java Server Pages*. Addison Wesley.
4. Fain, B. Responsive *Web Design with HTML5 and CSS3*. Packt Publishing Limited

Suggested E-Learning Material:

1. W3Schools website
   https://www.w3schools.com/xml/
2. HTML, CSS, and Javascript for Web Developers https://www.coursera.org/learn/html-css-javascript-for-web-developers
3. Internet Technology
   https://nptel.ac.in/courses/106105084/

IT 302L Internet and Web Technology Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**4**	**2**

Learning Outcomes:

After successful completion of the course students will be able to

- Design web pages containing tables, images and links using HTML and CSS.
- Design web pages using DIV, Class and ID selector.
- Design dynamic web pages using Java Script and PHP
- Develop a server side java application called JSP to catch form data sent from client, process it and store it on database.

Lab No.	**Topic**
Lab 1	Introduction to HTML and Web Browsers
Lab 2	Formatting Web Pages
Lab 5-Lab 6	Anchor tag, Image tag, List and Table formation
Lab 10-Lab 11	Color Schemes and Other Miscellaneous Tags
Lab 13-Lab 14	CSS (cascade style scheets), dynamically changing text and style
Lab 18-Lab 19	Dynamically Chaging Content of using Placement, Filyters and Transitions
Lab 25-Lab 26	Introduction to Scripting, Implications of using Script Tags in Various HTML Tags
Lab 30-Lab 31	Variable Declaration, Operators, Condition and Control Statements
Lab 35-Lab 36	Basic input/output functions of Java Script

Lab 40-Lab 41	Object Model, Simple Animation creation using Java Script and DHTML
Lab 44	Creation of XML File
Lab 45	DTD in XML

ELE 509 Microprocessors and Microcontrollers

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Recall and apply a basic concept of digital fundamentals to Microprocessor based personal computer system.
- Describe the architecture and Instruction set of Intel 8085 microprocessor.
- Provide practical hands on experience with Assembly Language Programming.
- Illustrate how the different peripherals (8255, 8253 etc.) are interfaced with Microprocessor.
- Distinguish and analyze the properties of Microprocessors & Microcontrollers.

Section A

8086/8088 Microprocessor: Pin Assignment, Architecture, Functional Diagram, Register Organization, Memory address space & data organization, Segment registers & Memory segmentation, Dedicated & general use of memory, Addressing modes, Instructions, Functional schematic, Minimum and Maximum mode operations of 8086, 8086 Control signal interfacing, Timing Diagrams, Interrupts, Bus timings, Demultiplexing. Assembly Language Programming of 8086: Instruction Format, Instruction Set, Data Transfer instructions, Arithmetic instructions, Logical instruction, Shift instructions, Rotate instructions, Flag control instructions, Compare instructions, Jump instructions, Subroutine & the subroutine handling instructions, Loop & loop handling instructions, String instructions.

Section B

Peripheral Devices and Their Interfacing: Introduction, memory and I/O interfacing with 8086, data transfer schemes, programmable peripheral

interface (8255), programmable DMA controller (8257), programmable interrupt controller (8259), programmable communication interface (8251), programmable counter/interval timer (8253 and 8254), special purpose interfacing devices, elements and circuits for interfacing. Communication Interface: Serial Communication Standards, USART Interfacing RS-232, IEEE-488, 20mA Current Loop, Prototyping and Trouble shooting, Software Debugging tolls, MDS.

Section C

Introduction to Microcontrollers: Overview of 8051 Micro Controller, Architecture, I/O ports and Memory Organization, Addressing modes and Instruction set of 8051, Simple Programs using Stack Pointer, Assembly language programming. 8051 Interrupts Communication: Interrupts, Timer/Counter and Serial Communication, Programming Timer Interrupts, Programming External H/W interrupts, Programming the serial communication interrupts, Interrupt Priority in the 8051, Programming 8051 Timers, Counters and Programming. Interfacing & Industrial Applications: Applications of Micro Controllers, Interfacing 8051 to LED's, Push button, Relay's and Latch Connections, Keyboard Interfacing, Interfacing Seven Segment Display, ADC and DAC Interfacing.

Suggested Books:

1. Ayala, K. J. (2008). *The 8051 Microcontroller-Architecture, Programming and Applications.*Thomson Publishers.
2. Hall, D. V. (1986). *Microprocessors and interfacing: programming and hardware*. McGraw-Hill, Inc..
3. Deshmukh, A. V. (2005). *Microcontrollers: theory and applications*. Tata McGraw-Hill Education.
4. Ray, A. K., & Bhurchandi, K. M. (2006). *Advanced Microprocessors and Peripherals*. Tata McGraw-Hill.
5. Ayala, K. J. (1995). *8086 Microprocessor: Programming and Interfacing the PC*. Delmar Thomson Learning.
6. Liu, Y. C., & Gibson, G. A. (1986). *Microcomputer systems: the 8086/8088 family: architecture, programming, and design*. Englewood Cliffs: Prentice-Hall.

Suggested E-Learning Materials

1. Microprocessors and Microcontrollers
   https://nptel.ac.in/courses/106108100/
2. Microprocessors and Microcontrollers
   https://freevideolectures.com/course/3018/microprocessors-and-microcontrollers

ELE 306L Microprocessors and Microcontrollers Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**2**	**1**

Learning Outcomes:

After successful completion of the course students will be able to

- Write programs to run on 8086 microprocessor based systems.
- Design system using memory chips and peripheral chips for 16 bit 8086 microprocessor.
- Understand and devise techniques for faster execution of instructions, improve speed of operations and enhance performance of microprocessors.
- Understand multi core processor and its advantages.

List of Experiments

1. Write a program to calculate the addition of 16-bit No.
2. Write a program to calculate the addition of 32-bit No.
3. To transfer the content of one memory location to other memory location.
4. To exchange the content of one memory location to other memory location.
5. To find out the maximum of N given nos.
6. To generate the fibonacci series.
7. To find location of given nos.
8. To find out the multiplication of two 16 –bit nos.
9. To find out the minimum of N given numbers.

CS 405 Compiler Design

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Specify and analyze the lexical, syntactic and semantic structures of advanced language features.
- Separate the lexical, syntactic and semantic analysis into meaningful phases for a compiler to undertake language translation

- Write a scanner, parser, and semantic analyzer without the aid of automatic generators
- Describe techniques for intermediate code and machine code optimization
- Design the structures and support required for compiling advanced language features.

Section A

Analysis of source programme, Different phases of a compiler, Symbol Table. **Lexical Analysis:** Different approaches to design a lexical analyzer, regular expression, finite automata (Deterministic & Non-deterministic). RE to NFA and NFA to DFA. Optimization of DFA states. Implementation of lexical analyzer (introduction). **Error Handling:** errors in different phases of compiler. Introduction to Compiler Construction Tools.

Section B

Syntax analysis: context free grammar, Parsing techniques (Top-down, Bottom-up, Operator-precedence, SLR, LALR). Intermediate code generation: Intermediate language, syntax directed translation, assignment statement, Boolean statements and back patching, array references, procedure calls and record structure.

Section C

Code optimization: Principal sources of optimization, Local & Loop optimization, loop invariant computations, induction variable elimination. Code generation: Design of code generation, a machine model, a simple code generator, register allocation & assignment, code generation from DAG's.

Suggested Books:

1. Aho, A. V., & Ullman, J. D. (1977). *Principles of Compiler Design*. Addison-Wesley Longman Publishing Co., Inc.
2. Jeffrey, A. V., Ullman, J. D. & Sethi R. (1986). *Compilers, Principles, Techniques, and Tools*. Wesley.
3. Barrett, W. A., & Couch, J. D. (1988). *Compiler construction: theory and practice*. Galgotia.
4. Tremblay, J. P., & Sorenson, P. G. (1985). *Theory and Practice of Compiler Writing*. McGraw-Hill, Inc.
5. Gries, D. (1987). *Compiler construction for digital computers*. New York: Wiley.

Suggested E-Learning Material:

1. Principles of Compiler Design
   https://nptel.ac.in/courses/106108113/
2. Compilers
   https://web.stanford.edu/class/archive/cs/cs143/cs143.1128/

CS 439L Compiler Design Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**2**	**1**

Learning Outcomes:

After successful completion of the course students will be able to

- Develop understanding for implementing programs for lex code.
- Implement program for Yacc tool to develop a scanner and parser.
- Apply the knowledge of patterns, tokens & regular expressions in programming for solving problems.

List of Experiments:

1. Revision of Basic Linux Commands like: Is, mkdir, rmdir, cd, cat, cp, rm, mv, vi, head, tail, cut, grep etc. (2 Labs)
2. Revision of C programs using gcc compiler like (Adding numbers, finding greater or lesser, generation of series, adding series, Using functions) (3 Labs)
3. Write a Lex code to check given string is keyword or identifier
4. Write a Lex code to match a given string
5. Write a Lex code to count vowel and consonant from input
6. Write a Lex code to count number ofprintfand scanf from C file
7. Write a Lex code to count number of identifiers from C file
8. Write a Lex code to count word, characters, blank spaces and lines
9. Write a Lex code to count number of comment lines
10. Write a Lex code to check the validity of arithmetic statement
11. Write a Lex code to find the number of constants
12. Write a Lex code to count number of keywords from C file
13. Write a Lex code to check statement is compound or simple
14. Write a Lex code to check number is integer or floating point

15. Write a Lex code which return type of relational operator like >,<,<=,>=,==
16. Write a Lex code to count escape sequences from C file
17. Write a Lex program to count the type of numbers
18. Write a Lex code to find longest word from the file
19. Write a Yacc code to check expressions are valid or not
20. Write a Yacc code to check given string is Keyword
21. Write a Yacc code to check variable declaration is correct or not like type varname
22. Write a Yacc code for checking parenthesis
23. Write a Yacc code to check compound statements are valid or not
24. Write a Lex and Yacc code for a simple desk calculator
25. Write a Lex and Yacc code for arithmetic operations on float variables
26. Write a Lex and Yacc code for checking if else statement from C file (2 Labs)
27. Write a Lex and Yacc code for evaluating postfix expressions (2 Labs)

CS 411 Computer Graphics

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Apply knowledge of mathematics, science, and engineering to implement basic transformation and scan conversion.
- Apply the knowledge of co-ordinate system that is necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- Apply aesthetic judgments and critical thinking skills to art and graphics related issues.
- Recognize and evaluate critical and aesthetic issues within computer graphics and the mixed media.

Section A

Components of Graphics Systems: Display devices - Refresh CRTs, Random scan and Raster scan monitors, color CRT monitors, DVST,

Plasma-panel displays, Hard copy devices-printers, plotters. Display processors-Random scan systems, Raster scan systems. Interactive Input devices: keyboards, touch panels, light pens, tablets, joysticks, trackball, mouse. Logical classification - Locator, Stroke, String, Valuator, Choice, Pick devices. Interactive picture construction techniques - positioning methods, constraints, grids, gravity field, rubber band methods, sketching, dragging.

Section B

Output primitives: Points and lines, DDA and Bresenham's line drawing algorithm, Antialiasing lines. Bresenham's circle drawing algorithm. Character generation. Area filling: Scan line, Boundary-fill, Flood-fill algorithm. 2-D Transformations: Basic Transformations, General Transformation equations, Reflection, Shear. Windowing and clipping: Windowing concepts, Line, Area, Text clipping algorithms, Window to View port Transformation. Segmentation: Concepts, Segment files, segment attributes.

Section C

3D Transformation: 3D co-ordinates. Basic 3D transformations. Rotation about arbitrary axis. Reflection, shear, viewing transformation. Curved lines and Surfaces: Polygon surface, Bezier Curves and surfaces, spline curves and surfaces. Fractals Geometry Methods: Introduction. Hidden surface and hidden line removal: Classification of algorithms, Back-face removal, Depth buffer method, Scan line method, Depth sorting method, Area subdivision method. Comparison. Shading: Constant intensity, Gouraud shading, Phong shading, Ray-tracing algorithms.

Suggested Books:

1. Hearn, D., & Baker, M. P. (1996). *Computer Graphics*. Person Education Inc.
2. Newman, W. M., & Sproull, R. F. (1979). *Principles of interactive computer graphics*. McGraw-Hill, Inc.
3. Harrington, S. (1987). *Computer Graphics: A Programming Approach*. Mc-Graw Hill.
4. Foley, J. D., & Van Dam, A. (1982). *Fundamentals of interactive computer graphics*. Reading, MA: Addison-Wesley.
5. Giloi, W. K. (1978). *Interactive computer graphics: data structures, algorithms, languages*.
6. Roy, A. P., & Kalley, G. (1987). *Theory and Problems of Computer Graphics*. Schaum's outline series in Computers.Mc-Graw Hill.

Suggested E-Learning Material:

1. Computer Graphics
   https://nptel.ac.in/courses/106106090/
2. Computer Graphics
   https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-837-computer-graphics-fall-2012/

CS 411L Computer Graphics Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**4**	**2**

Learning Outcomes:

After successful completion of the course students will be able to

- Implement various line drawing and circle drawing algorithms.
- Implement algorithms for polygon drawing.
- Implement boundary fill algorithm and flood-fill Algorithm to fill convex regions.
- Implement problems based on object translations, scaling, rotations and projections.
- Implement algorithms based on line clipping, anti-aliasing and curve fitting.

Lab No.	**Program**
LI &L2	Implementation of in-built functions of C-language in Graphics.
L 3	Implementation of Vector Generation Technique and DDA Line Drawing Algorithm.
L 4	Implementation Bresenham's Line Drawing Algorithms.
L 5	Implementation of Simple Circle drawing Algorithm and using Trigonometric method.
L 6	Implementation of the Bresenham's Circle Drawing Algorithm, and Ellipse drawing by modifying Bresenham's Circle drawing algorithm.
L 7	Implementation of the Mid-point Circle Drawing Algorithm.
L 8	Implementation of Line and Point method of polygon drawing.

L 9	Implementation of Inside/Outside test of pixels in respect to a polygon.
L 10	Implementation of the Boundary Fill Algorithm and Flood-Fill Algorithm to fill convex regions.
L I 1	Implementation of Scan Line Conversion Algorithm for Polygon Filling (concave region).
L 12	Problems based on object translations using equations.
L I 3	Problems based on object scaling using equations.
L 14	Problems based on object rotations using equations.
L 15	Problems based on object translations using homogeneous matrices.
L 16	Problems based on object scaling using homogeneous matrices.
L 17	Problems based on object rotations using homogeneous matrices.
L18-L19	Problems based on object reflections using homogeneous matrices.
L 20	Problems based on object shear using homogeneous matrices.
L21-L22	Problems based on composite 2D transformations on any object using homogeneous matrices.
L 23	Implementation of Gupta-Sproull Anti-Aliasing method.
L 24	Problems based on Point Clipping.
L 25	Problems based on Cohen Sutherland Line Clipping Algorithm.
L 26	Problems based on Liang Barsky Line Clipping Algorithm.
L 27	Problems based on Sutherland Hodgeman Polygon Clipping Algorithm.
L 28	Implementation of Hilbert Curve and Koch curve.
L 29	Problems based on Segments.
L 30	Problems based on Character Generation using raster approach.
L 31	Problems based on Simple Parallel Projection.
L 32	Problems based on Simple Perspective Projection

CS 508 Big Data Analytics

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Understand big data analytics and identify the main sources of large scale big data in the real world.
- Learn various frameworks like Hadoop. NOSQL to efficiently store retrieve and process Big Data for Analytics.
- Implement several Data Intensive tasks using the Map Reduce Paradigm in Hadoop.
- Program applications using tools like Hive, pig, NO SQL for Big data Applications.
- Construct scalable algorithms for large Datasets using Map Reduce techniques.
- Apply the knowledge of Big Data gained to fully develop DBA applications for real life applications.

Section A

Introduction to Big Data Analytics, Evolution, Structuring Big Data, Types of Big Data, 4Vs, Big Data Analytics: Advantages, Applications. Comparing Report and Analysis. The Analytic Process, Types of Analytics. Characteristic of Big Data Analytics. Framing the Problem for Analytics. Statistical Significance or Business Importance of Analytics. Making Inferences. Analytic Approaches: History and Ensemble Methods, Graphical User Interface, Data Visualization for Big Data.

Section B

Gathering Data on a Distributed Environment. Architecture, Features of Hadoop Framework: HDFS, Map Reduce, YARN, Hbase, Hive, Sqoop, Zookeepker, Oozie. Exporting Data to HDFS and Importing Data from HDFS, HDFS Commands. HBase Architecture, Storing Big Data with Hbase, Interacting with Hadoop Ecosystem, Combining HBase and HDFS.

MapReduce Framework, Working of MapReduce, Techniques to Optimize MapReduce Jobs. Building and Executing Applications. Controlling MapReduce Execution with InputFormat, Taking Input from files and applying operations for customization.

Section C

Understanding Hive, Hive Variables, Properties, Queries and Data Types. Built in Functions in Hive. Working with Databases in Hive: Creating, Viewing, Droping and Altering. Creating and Modifying Tables. Using Hive DDL Statements and DML Statements. Executing HiveQL. Applying Joins, Group By and Order By clauses.

Pig Architecture. Properties of Pig, Running Pig Programs, Working with Operators in Pig, Working with Functions in Pig.

Suggested Books:

1. White, Tom. (2012). *Hadoop: The definitive guide*. O'Reilly Media, Inc.
2. Miner, D. & Shook, A. (2012). *MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems*. O'Reilly Media, Inc.
3. Loshin, D. (2013). *Big data analytics: from strategic planning to enterprise integration with tools, techniques, NoSQL, and graph*. Elsevier.

Suggested E-Learning Material:

1. Big Data & Analytics by Kent State University
   https://www.cs.kent.edu/~jin/BigData/index.html
2. Big Data Specialization by University of California San Diego
   http://www.coursera.org/specializations/big-data

CS 508L Big Data Analytics Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**6**	**3**

Lab No.	**Problems**
L1-L2	Basic Linux command for listing, making and changing the directories and files.
L3-L4	Linux file system security command: access rights and changing access rights.
L5-L6	Linux file system command for processes and jobs.

L7	Demonstrate the look and feel of cloudera and hadoop ecosystem.
L8	Demonstrate the various demons of hadoop file system.
L9-L10	HDFS commands.
L11	Import and export the input and output files from local file system to HDFS and vice versa.
L12	Sharing the files and directories from Windows to Cloudera.
L13-L16	Compilation and Execution of MapReduce programming example in HDFS environment.
L17-L18	Working with database in apache Hive: creating, Viewing, Dropping and Altering.
L19-L22	Working with Apache Hive Operators, Functions and Join operation.
L23-L24	Apache Hive DDL and DML commands.
L25	HiveQL: Group By and Order By clauses.
L26-30	Working with Apache PIG Latin Operators and Functions.

*In Hadoop

IT 410 Information Systems and Securities

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Appreciate the value of information to the modern organization.
- Describe the key encryption techniques of cryptography.
- Appreciate the difficulties that arise when valuable information needs to be shared.
- Learn Confidentiality, Integrity and Availability.
- Apply protocols to implement secure message exchanges.

Section A

Foundations of Cryptography and Security, Ciphers and Secret Messages, Security Attacks and Services, Mathematical Tools for Cryptography, Substitutions and Permutations, Modular Arithmetic, Euclid's Algorithm, Conventional Symmetric Encryption Algorithms, Theory of Block Cipher Design, DES and Triple DES, Modes of Operation (ECB, CBC, OFB, CFB), Strength of DES, Modern Symmetric Encryption Algorithms, RC5 Stream Ciphers, One Time Pad, Cryptanalysis.

Section B

Public Key Cryptography, Prime Numbers and Primality testing, Factoring Large Numbers, RSA, attacks on RSA, Diffie-Hellman, Algorithm, Public-Key Cryptography Standards, Hashes and Message Digests, Message Authentication, MD5, SHA, Digital Signatures, Certificates, Digital Signature Standard (DSS and DSA),

Section C

Authentication of Systems, Kerberos (V4 and V5) and VeriSign, Electronic Mail Security (Pretty Good Privacy, S/MIME), IPSec and Web Security, Intrusion detection systems, Secure Sockets and Transport Layer (SSL and TLS), Electronic Commerce Security, Secure Electronic Transaction (SET), E-Cash (DigiCash), Digital Watermarking and Steganography.

Suggested Books:

1. William, S. (1999). *Cryptography and network security: principles and practice*. Prentice-Hall, Inc.
2. Schneier, B. (2007). *Applied cryptography: protocols, algorithms, and source code in C*. John wiley & sons.
3. Schneier, B. (2011). *Secrets and lies: digital security in a networked world*. John Wiley & Sons.

Suggested E-Learning Material:

1. Introduction to Computer Security
   https://www.cs.northwestern.edu/~ychen/classes/cs350-w07/lectures.html
2. Cryptography and Network Security
   https://nptel.ac.in/courses/106105031/

IT 401 Data Mining and Warehousing

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Describe the basic concepts of data mining and data warehousing.
- Apply skills for different data mining techniques in the analysis of data.
- Describe the schema and organization of data in data warehouse.
- Apply data mining techniques in wide variety of data like spatial, time series, text, multimedia and World Wide Web.
- Get experience and encouragement of exploring data mining techniques in real world and doing research.

Section A

Introduction to data mining - Definition, why data mining, on what kind of data, knowledge discovery in databases (KDD), appropriateness of data mining, expert systems vs. data mining systems, data mining functionalities, classification of data mining systems, data mining techniques, major issues. **Data Preprocessing** - data cleaning, integration and transformation, data reduction, data discretization and concept hierarchy generation.

Section B

Association rules - Market Basket Analysis, Apriori algorithm for generating association rules, FP-growth algorithm. **Classification and prediction -** decision tree induction, other methods for classification (introduction only), Prediction - linear and non linear regression, Evaluating the accuracy of a classifier or predictor.

Clustering - Categorization of Major cluster methods, the K-means algorithm, hierarchical clustering (agglomerative and division method).

Section C

Data Warehouse - difference between operational database and warehouse, data warehouse design, three tier architecture, online analytical processing (OLAP), data warehouse implementation. Trends in data mining – system products and research prototypes. Social impacts of data mining. Applications of data mining. Brief overview of mining time series databases, spatial databases and World Wide Web mining.

Suggested Books:

1. Han, J., Pei, J., & Kamber, M. (2011). *Data mining: concepts and techniques*. Elsevier.
2. Roiger, R. J. (2017). *Data mining: a tutorial-based primer*. Chapman and Hall/CRC.
3. Berry, M. J., & Linoff, G. S. (2009). *Data mining techniques*. John Wiley & Sons.
4. Adriaans, P., & Zantinge, D. (2000). *Data Mining*. Addison Wesley.

Suggested E-Learning Material:

1. Data Mining
   https://nptel.ac.in/courses/106105174/
2. Data Mining: Concepts and Techniques
   https://hanj.cs.illinois.edu/bk3/bk3_slidesindex.htm

IT 401L Data Mining and Warehousing Lab

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**0**	**0**	**4**	**2**

Learning Outcomes:

After successful completion of the course students will be able to

- Implement programs for data preprocessing and data analysis.
- Use association rule mining in programs for mining of different kinds of data.
- Implement classification and clustering algorithms for data mining.

Lab No	**Problems**
L 1-L5	Introduction to the exploratory data analysis
L6–L10	Performing data preprocessing for data mining
L11-L13	Performing Association rule analysis
L14-L6	Performing Classification
L17-L18	Performing Clustering
L19-L20	Performing Regression

Discipline Electives

CS 441 Computer Vision

	L	T	P	C
Max. Marks : 100				
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Identify basic concepts, terminology, theories, models and methods in the field of computer vision.
- Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.
- Assess which methods to use for solving a given problem, and analyze the accuracy of the methods.

Section A

Introduction: Motivation, Introduction to Computer Vision and Image Analysis, Human Eye, Camera model, CCD camera, Human colour perception, Colour models.

Segmentation: Threshold based segmentation, Edge based segmentation, Border detection, Hough transform, Region based segmentation, Watershed segmentation, Evaluation issues in segmentation, Mean shift segmentation, Active contour models, Level sets and Geodesic active contours, Optimal single and multiple surface segmentation.

Section B

Shape Representation and Description: Region identification, Contour based shape representation and description, Boundary description, B-splines, Shape invariants, Moments, Shape classes.

Object Recognition: Classification principles, SVM, Neural nets, Syntactic pattern recognition,

Image Understanding: Image understanding control strategies, Hierarchical control, Bottom-up control, Model-based control, Classification based segmentation, Contextual image classification, Scene labelling, Semantic image segmentation, Hidden Markov models, Bayesian belief network.

Section C

3D Vision: Marr's theory, Active and Purposive vision, A single perspective camera, Camera Calibration from a known scene, Scene reconstruction from multiple views, Two camera, Stereopsis, Relative

motion of the camera, Fundamental matrix, Stereo correspondence algorithms, Photometric stereo, Shape from motion, Shape from texture, 3D model based vision, Multi view representation.

Tracking: Object tracking, Motion models, Kalman Filtering, Feature fusion in a Particle filter, Multi target tracking.

Applications: Intelligent video surveillance, Mobile robots, Medical imaging, Human object identification, digital libraries, image based rendering, Deep Learning for Computer Vision

Suggested Books:

1. Sonka, M., Hlavac, V., & Boyle, R. (2014). *Image processing, analysis, and machine vision*. Cengage Learning.
2. Szeliski, R. (2010). *Computer vision: algorithms and applications*. Springer Science & Business Media.
3. Forsyth David, A., & Jean, P. (2002). *Computer Vision: a modern approach*. PHI.
4. Cipolla, R., Battiato, S., & Farinella, G. M. (Eds.). (2010). *Computer Vision: Detection, recognition and reconstruction* (Vol. 285). Springer.

Suggested E-Learning Material:

1. Computer Vision: Foundations and Applications
   http://vision.stanford.edu/teaching/cs131_fall1415/schedule.html
2. Deep Learning in Computer Vision
   https://www.coursera.org/learn/deep-learning-in-computer-vision

CS 419 Distributed Computing

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Study software components of distributed computing systems. Know about the communication and interconnection architecture of multiple computer systems.
- Give the hardware and software concepts of distributed operating systems, various design issues like transparency, flexibility etc., and communication and synchronization in distributed operating systems.

- Apply scheduling in distributed operating systems, fault tolerance, real-time distributed systems, and designing of distributed file systems.
- Develop various synchronous and asynchronous algorithms: Leader election, shortest path problem, minimal spanning tress, randomized co-ordinate attack problem, consensus problems and construction of the breath first tree, spanning tree, and maximal independent set.
- Have in-depth knowledge of asynchronous shared memory model including various classical algorithms of mutual exclusion and resource allocation.

Section A

Distributed Operating System: Distributed Computing system models, Issues in design of distributed operating system, message passing, Remote Procedure Calls, synchronization, process management, resource management, distributed file systems. Introduction to distributed data - bases.

Section B

Distributed Algorithms: Introduction to distributed algorithms, synchronous and partial synchronous models, Algorithms in general synchronous leader election, Breadth first search, shortest path, randomized algorithms. Distributed concensus with link and process failures. Asynchronous system model, I/O automata, operation of automata, complexity measures, randomizations,

Section C

Asynchronous shared memory model, mutual exclusion, resource allocation, concensus, Asynchronous network model, basic asynchronous network algorithms, shared memory Vs Networks. Introduction to parallel distributed processing: general framework, methods of learning.

Suggested Books:

1. Sinha, P. K. (1998). *Distributed operating systems: concepts and design*. PHI Learning Pvt. Ltd.
2. Tanenbaum, A. S. (2009). *Modern operating system*. Pearson Education, Inc.
3. Lynch, N. A. (1996). *Distributed algorithms*. Elsevier.
4. Rumelhart, D. E., McClelland, J. L., & PDP Research Group. (1987). *Parallel distributed processing* (Vol. 1 & Vol. 2). Cambridge, MA: MIT press.

5. Haykin, S. (1994). *Neural networks: a comprehensive foundation*. Prentice Hall PTR.

Suggested E-Learning Material:

1. Distributed Systems

   https://nptel.ac.in/courses/106106168/

2. Tanenbaum, A. S., & Van Steen, M. (2007). *Distributed systems: principles and paradigms*. Prentice-Hall.

   https://www.distributed-systems.net/index.php/books/distributed-systems-3rd-edition-2017/

CS 602 Digital Image Processing

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Describe the basics of Digital Image Processing & thorough understanding of linear systems, matrix theory, image sampling and quantization.
- Illustrate image enhancement techniques in spatial and frequency domain.
- Employ concepts related to image restoration and analysis.
- Use techniques related to feature extraction, edge detection and segmentation.
- Describe basic concepts of pattern recognition, statistical decision making and clustering.

Section A

Image processing: Introduction, linear systems, the Fourier transform, matrix theory results. Image perception, image sampling, Quantisation: the optimal mean square (Lloyd-max quantiser), visual quantizaiton. Image transforms: two dimensional orthogonal and unitary transforms, properties, one dimensional discrete Fourier transform (DFT), two dimensional DFT, cosine transform, sine transform.

Section B

Image enhancement: Point operation, histogram modeling, spatial operations, transform operation, multispectral image enhancement, false

color and pseudocolor, color image enhancement. Image filtering: image observation models, inverse and Wiener filtering, finite impulse response (FIR) wiener filtering, other Fourier domain filters.

Section C

Image Analysis: Feature extraction, Edge detection, Scene segmentation and labeling. Pattern recognition: Introduction, Recognition process, Statistical decision making (Bayes' theorem), Nonparametric decision making (Nearest neighborhood classification tech), clustering.

Suggested Books:

1. Jain, A. K. (1989). *Fundamentals of digital image processing*. Englewood Cliffs, NJ: Prentice Hall.
2. Gonzalez, R. C., & Woods, R. E. (2002). Digital image processing. Pearson Education.
3. Rosenfeld, A. (1976). *Digital picture processing*. Academic press.
4. Pratt, W. K. (2007). *Digital image processing: PIKS Scientific inside*. Hoboken, New Jersey: Wiley-interscience.
5. Duda, R. O., Hart, P. E., & Stork, D. G. (2012). *Pattern classification*. John Wiley & Sons.
6. Friedman, M., & Kandel, A. (1999). *Introduction to pattern recognition: statistical, structural, neural and fuzzy logic approaches*. World Scientific Publishing Company.
7. Charniak, E. (1985). *Introduction to artificial intelligence*. Pearson Education India.

Suggested E-Learning Material:

1. Digital Image Processing
   https://web.stanford.edu/class/ee368/
2. Digital Image Processing
   https://nptel.ac.in/courses/117105079/

CS 431 Real Time Systems

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Present the mathematical model of the system.

- Develop real-time algorithm for task scheduling.
- Illustrate the working of real-time operating systems and real-time database.
- Work on design and development of protocols related to real-time communication.

Section A

Introduction to Real-time computing: Characterizing Real-time system & tasks; Performance measures of real time systems, estimation of program run time, Real-time system design: Hardware requirement, system-development cycle, data transfer techniques, synchronous & asynchronous data communication, standard interfaces.

Section B

Task Assignment and Scheduling: Priority scheduling, scheduling with fixed priority dynamic priority scheduling, Real-time programming languages & Tool: desired language characteristics, data typing, control structure, run time error handling, overloading & generics, run time support, Real-time databases.

Section C

Real time communication algorithms, Fault tolerence techniques: Causes of failure, fault types, fault detection, redundancy, integrated failure handling Reliability Evaluation techniques: Parameter values, reliability model for hardware redundancy, software error model, Clock synchronization.

Suggested Books:

1. Krishna, C. M. (2001). *Real Time Systems*. Wiley Encyclopedia of Electrical and Electronics Engineering.
2. Mathai, J. (1996). *Real-time systems: specification, verification and analysis*. Prentice Hall International series in Computer Science.
3. Lawrence, P. D., & Mauch, K. (1987). *Real-time microcomputer system design: an introduction*. McGraw-Hill, Inc.
4. Bennett, S. (1994). *Real-time computer control: an introduction*. Englewood Cliffs: Prentice Hall.
5. Young, S. J. (1982). *Real time languages*. Horwood.

Suggested E-Learning Material:

1. Real-Time Systems

   http://www.cse.chalmers.se/edu/year/2015/course/EDA222_Real_Time_Systems/Documents/Slides/

2. Fault Tolerance

   https://www.coursera.org/lecture/big-data-essentials/fault-tolerance-rcwk5

CS 433 Soft Computing

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Apply the theory and concepts of neural networks, neuro-modeling, several neural network architectures and their applications.
- Describe the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic.
- Describe evolutionary computation like genetic algorithms and its power to optimize the problem in hand.

Section A

Neural Network (NN) Paradigms: Introduction, Neuron model, Neural network architectures, Learning Rules (Hebbian, Competitive, Baltzmann, Supervised, unsupervised) Types of neural networks: Perceptron, MLP, radial basis function network, recurrent network, self organizing Feature maps, Boltzamann m/c, Applications of NN.

Section B

Fuzzy Logic: Introduction, Fuzzy sets, Basic operations on fuzzy sets, relations, rule based models and linguistic variables, fuzzy control, interpolation in fuzzy rule base, Applications of Fuzzy logic.

Section C

Evolutionary Computations: Introduction, Genetic Algorithm (GA), Evolutionary programming, Classifier systems, genetic programming parse trees, Mathematical foundation of GA variants of GA (hybrid GA, Fuzzy GA Enhancements of genetic programming, application).

Suggested Books:

1. Zimmermann, H. J. (1996). *Fuzzy Set Theory—and Its Applications*. Springer, Dordrecht.
2. Haykin, S. (1994). *Neural networks: a comprehensive foundation*. Prentice Hall PTR.
3. Li, H., Li, H. H., & Gupta, M. M. (1995). *Fuzzy logic and intelligent systems*. Springer Science & Business Media.

4. Jain, L. C., & Kacprzyk, J. (1997). *Soft computing techniques in knowledge-based intelligent engineering systems: approaches and applications*. Physica-Verlag.
5. Geyer-Schulz, A. (1997). *Fuzzy rule-based expert systems and genetic machine learning*. Physica Verlag.
6. Yegnanarayana, B. (2009). *Artificial neural networks*. PHI Learning Pvt. Ltd..
7. Valluru, B. R. & Hayagriva, V. R. (1995). *C++ neural networks and fuzzy logic*. MIS Press; New York, USA.
8. Ruan, D. (Ed.). (2013). *Fuzzy systems and soft computing in nuclear engineering*. Physica.
9. Anderson, J. A. (1995). *An introduction to neural networks*. MIT press.
10. Kosko, B. (1992). *Neural networks and fuzzy systems: a dynamical systems approach to machine intelligence*. Prentice hall.

Suggested E-Learning Material:

1. Neuro-Fuzzy and Soft Computing
   http://www.cs.nthu.edu.tw/~jang/nfsc.htm
2. Introduction to Soft Computing
   https://nptel.ac.in/courses/106105173/
3. Neural Networks and Deep Learning
   https://www.coursera.org/courses?query=neural%20networks

IT 412 Internet of Things

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Understand the concept of IoT.
- Understand what constitutes an IoT design solution.
- Identify the sensors and basic electronic design needed for different IoT solutions.
- Analyze basic proptocols of IoT.
- Implement basic IoT applications on Arduino and Raspberry Pi to provide IoT solutions for various domains.

Section A

Introduction of IoT, M2M (Machine-to-Machine) towards IoT-the global context, Differing Characteristics.

M2M to IoT – Introduction, Some Definitions, industrial structure for IoT, architecture for conversion of **M2M to IoT**, design principles ,capabilities of IoT, IoT architecture , standard protocol, **IoT Architecture Reference Model,** Functional View, Information View, Deployment and Operational View, **Domain specific applications of IoT**: Home automation, Industrial applications, Surveillance applications, Other IoT applications

Section B

Introduction to concept of IoT devices, IoT devices versus computers, IoT configurations, basic components, networking, sensors, introduction to embedded systems Introduction to Arduino, types of Arduino, Arduino toolchain, Arduino programming structure, Sketches, Pins, Input-output from pins using sketches, Introduction to Arduino shields, Introduction to Raspberry-Pi microcomputer Accessing GPIO pins, Sending and receiving signals using GPIO pins

Section C

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT,Security in IoT protocols.

Suggested Books:

1. Holler, J., Tsiatsis, V., Mulligan, C., Karnouskos, S., Avesand, S., & Boyle, D. (2014). *Internet of Things*. Academic Press.
2. Bahga, A., & Madisetti, V. (2014). *Internet of Things: A hands-on approach*. Vpt.
3. DaCosta, F. (2014). *Rethinking the Internet of Things: a scalable approach to connecting everything*. Apress.

Suggested E-Learning Material:

1. Introduction to Internet of Things

   https://onlinecourses.nptel.ac.in/noc19_cs31
2. Introduction to the Internet of Things (IoT)

   https://www.edx.org/course/introduction-to-the-internet-of-things-iot-1
3. IoT Sensors and Devices

   https://www.edx.org/course/sensors-and-devices-in-the-iot

CS 445 Pattern Recognition

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Explain and define concepts of pattern recognition.
- Explain and distinguish porocedures, methods and algorithms related to pattern recognition.
- Apply methods from the pattern recognition for new complex applications.
- Analyze and breakdown problem related to the complex pattern recognition system.
- Design and develop a pattern recognition system for the specific application.
- Evaluate quality of solution of the pattern recognition system.

Section A

Introduction: Supervised and unsupervised learning, Data mining, Knowledge Representation

Bayes Decision Theory: Bayes decision rule, Minimum error rate classification, Normal density and discriminant functions, Bayesian networks, Compound decision theory

Maximum-Likelihood and Bayesian Parameter Estimation: Maximum-Likelihood Estimation, Bayesian Parameter Estimation, Some Common Statistical Distributions, Dimensionality and Computational Complexity, Principal Components Analysis, Fisher Linear Discriminant.

Section B

Expectation Maximization, Sequential Data and Hidden Markov Models, Liner dynamic systems

Nonparametric Techniques: Density Estimation.

Discriminative Methods: Nearest neighbour Classification, Fuzzy Classification, Linear Discriminant Functions, Hyperplane Geometry, Gradient Descent and Perceptrons, Minimum Squared Error Procedures, Support Vector Machines, Dual algorithm.

Section C

Artificial Neural Networks: Biological Motivation, Gradient descent, Multilayer networks, Back-Propagation algorithms, Hidden layer representation, Example of Face recognition.

Non-Metric Methods: Recognition with Strings, String Matching.

Algorithm-Independent Machine Learning: No-Free Lunch Theorem, Bias and Variance, Resampling for Estimation, Bagging and Boosting, Estimation of Misclassification, Classifier Combination.

Suggested Books:

1. Bishop, C. M. (2006). *Pattern recognition and machine learning*. Springer.
2. Duda, R. O., Hart, P. E., & Stork, D. G. (2012). *Pattern classification*. John Wiley & Sons.
3. Theodoridis, S., & Koutroumbas, K. (2010). *Pattern Recognition*. Academic Press, Inc.

Suggested E-Learning Material:

1. Introduction to Pattern Recognition
   https://cedar.buffalo.edu/~srihari/CSE555/
2. Introduction to Pattern Recognition, Artificial Neural Networks, and Machine Learning
   http://www.cs.ucsb.edu/~yfwang/courses/c

RS 401 Geoinformatics

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Describe spatial database, Co-ordinate and projection system
- Analyze vector and raster based analysis in Geographical Information Sciences
- Describe different types of satellite system and digital image processing
- Describe global cover based global position systems i.e. GPS, GLONASS
- Describe applications of remote sensing and GIS in natural resources management

Section A

Geographical Information System: Definition, Components of GIS, Hardware and software requirements for GIS, Coordinate system and projections, Database structure and formats, Spatial data models - raster and vector. Data inputting, Data base design - editing and topology creation. Linkage between spatial and Non spatial data, Query (Attribute/Spatial), Vector based analysis. Raster based analysis. Errors, Digital Elevation Model, Network analysis, O'pen source and WebGIS.

Section B

Remote Sensing: Definition - components of remote sensing - energy sensor, interacting body; Type - active and passive remote sensing. Satellite System - meteorological, communication and remote sensing. Platforms - aerial and space, synoptivity and repeativity. Electromagnetic Radiation (EMR) - EMR spectrum- visible, infrared [IR) middle IR, thermal IR and microwave. EMR interaction with earth surface material, radiance, irradiance, incident, reflected, absorbed and transmitted energy, spectral response pattern - spectral signature curves (water, soil and vegetation].

Digital Image Processing : Digital Image, Satellite Image - characteristics and formats. Resolution - spatial, spectral, radiometric and temporal; Introduction to rectification, enhancement; Classification - Unsupervised and Supervised classification.

Section C

Global Positioning System: Global Navigation Satellite System (GNSS), GPS, GLONASS, GALILEO, Segments - space, control, user, GPS Satellite signals, sources of errors and corrections.

Applications of Remote Sensing and GIS:

Applications of GIS and Remote Sensing in resource management (forestry, agriculture, urban telecommunication, transportation, water resources and environment).

Suggested Books:

1. Lo, C. P., & Yeung, A. K. (2002). *Concepts and techniques of geographic information systems*. Upper Saddle River, NJ: Prentice Hall.
2. Ian, H. (2010). *An introduction to geographical information systems*. Pearson Education India.
3. Joseph, G. (2005). *Fundamentals of remote sensing*. Universities press.

4. Jensen, J. R., & Lulla, K. (1987). *Introductory digital image processing: a remote sensing perspective*. Prentice Hall.

5. Sabins, F. F., & Sensing, R. (1987). *Principles and interpretation: Remote sensing.* San Francisco.

Suggested E-Learning Material:

1. GIS in Civil Engineering
   https://nptel.ac.in/courses/105102015/
2. Geospatial Information and Services
   http://www.oc.nps.edu/oc2902w/gis/gisdemo/

CS 528 Modeling and Simulation

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Describe the components of system and its principles.
- Illustrate conceptualization of model in system analysis, design and postulation.
- Describe the role of creating a model for any system in simulating it.
- Describe the applications of various simulation techniques in various real life scenarios.
- Learn the different statistical techniques used in simulation process and describe the characteristics of different simulation languages and their use.

Section A

Modeling: Definition of a SYSTEM, System concepts, types of system, continuous & discrete systems, modeling process, verification & validation. **Simulation:** Introduction, classification of simulation models, advantages and disadvantages of simulation, discrete system simulation: Monte Carlo method, Random Number Generation.

Section B

Queuing Theory: Introduction, Notation and assumption, Queuing model with poison input, exponential service and arbitrary service times, Simulation of queuing system, Simulation of a single-server queue,

Simulation of two-server queue. Inventory Control: Elements of inventory theory, more complex inventory models, finite and infinite delivery rate model with and without back ordering, Simulation of inventory systems.

Section C

Evaluation of simulation, length of simulation runs, variance reduction techniques. Project management: PERT/CPM techniques, simulation of PERT networks, Model as components of information systems, modeling for decision support, Virtual reality: The ultimate interactive model.

Suggested Books:

1. Gordon, G. (1969). System simulation.Prentice Hall of India.
2. Payne, J. A. (1982). *Introduction to Simulation: Programming Techniques and Methods Analysis*. McGraw-Hill, Inc.
3. Deo, N. (1983). *System simulation with digital computer*. Englewood Cliffs (NJ): Prentice-Hall.

Suggested E-Learning Material:

1. Modelling and Simulation of Descrete Event System
   https://nptel.ac.in/courses/112107220/
2. Simulation and modeling of natural processes
   https://www.coursera.org/lecture/modeling-simulation-natural-processes/modeling-and-simulation-F7vas

MCTR 403 Robotics and Automation

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Develop skills of creating industrial and mobile robot projects
- Implement robots like KUKA, PUMA in real industrial world
- Create innovative robot designs using mathematical concepts of kinematics
- Develop autonomous mobile robots in surveillance, security, home and office services.

Section A

Basic Concepts - Automation and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system, Dynamic stabilization of Robotics.

Power Sources and Sensors- Hydraulic, Pneumatic and electric drivers – Determination HP of motor and gearing ratio, variable speed arrangements, Path Determination - Machinery Vision – Ranging – Laser – Acoustic, Magnetic Fiber Optic and Tactile Sensor.

Section B

Manupulators - Construction of Manupulators, Manupulator Dynamic and Force Control, Electronic and Pneumatic manupulators.

Acuators and Grippers - Pneumatic, Hydraulic Actuators, Stepper Motor Control Circuits, End Effecter, Various types of Grippers, Design consideration.

Differential transformation and manipulators, Jacobians – problems.Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Section C

Kinematics - Forward and Inverse Kinematic Problems, Solutions of Inverse Kinematic problems, Multiple Solution, Jacobian Work Envelop – Hill Climbing Techniques.

Path Planning - Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion – straight line motion – Robot programming, languages and software packages.

Case Study - Multiple Robots – Machine Interface – Robots in Manufacturing and Non-Manufacturing applications – Robot Cell Design Selection of a Robot.

Suggested Books:

1. Groover,M. P.(2017). *Industrial Robotics: Technology, Programming, and Applications* (2nd ed.). Pearson Education.
2. Niku, S. B. (2011). *Introduction to Robotics* (2nd ed.). Wiley.
3. Fu, K.S., Lee,C.S. G. &Gonzalez, R. (1987) . *Robotics: Control,Sensing, vision and intelligence*. Tata McGraw-Hill Education
4. Mittal, R.K.& Nagrath, I. J.(2018). *Robotics and Control*. Tata McGraw-Hill Education.

5. Craig, J. J. (2008). *Introduction to Robotics: Mechanics and Control* (3rd ed.). Pearson Education.
6. Spong, M. W. &Vidyasagar, M. (2008). *Robot Dynamics and Control*. John Wiley & Sons.
7. Siciliano , B. & Sciavicco, L. (2010). *Robotics: Modelling, Planning and Control*. Springer.

Suggested E-Learning Material:

1. https://nptel.ac.in/courses/112101099/
2. https://www.edx.org/course/robotics-1
3. https://www.coursera.org/specializations/robotics
4. https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/
5. https://www.edx.org/course/robotics-dynamics-control-pennx-robo3x
6. https://onlinecourses.nptel.ac.in/noc18_me61/preview
7. https://swayam.gov.in/courses/4859-july-2018-robotics
8. https://www.edx.org/learn/robotics
9. https://www.coursera.org/specializations/roboticsl

IT 413 Multimedia Systems

Max. Marks : 100	**L**	**T**	**P**	**C**
(CA: 40 + ESA: 60)	**4**	**0**	**0**	**4**

Learning Outcomes:

After successful completion of the course students will be able to

- Develop technical aspect of Multimedia Systems.
- Describe various file formats for audio, video and text media.
- Design interactive multimedia software.
- Apply various networking protocols for multimedia applications.
- Evaluate multimedia application for its optimum performance.

Section A

Multimedia Basic: Introduction, Elements of multimedia. Applications, Conversion of computer, communication and entertainment products, Framework, Multimedia hardware: memory and storage devices,

communication devices, I/O devices, Multimedia software tools. Stages of multimedia design. Multimedia authoring tools.

Image: Types of graphics-vector & raster, pixel, pixel depth, image resolution, color, color-palates. Various file formats: GIF, JPEG, PNG, TIFF, BMP, Imagecompression: steps and types, Basic compression techniques: Run-Length Encoding, Zero Suppression, Huffman Coding. JPEG compression: lossy sequential DCT based Mode, Expanded lossy DCT based Mode, lossless Mode.

Section B

Sound: Basic sound concepts: frequency, amplitude, psychoacoustics, Digital representation of sound: Time domain sample representation, Transmission of digital sound. Digitization of audio signal.

MIDI: Concepts, devices, SMPTE timing standard.

Various audio formats: MP3, MP4, MP5, WAV etc.

Section C

Virtual Reality: Concepts, Devices, Applications, VRML (VR modelling language).

Animation: Principles of animation and its use in multimedia, Animation techniques. Animation file formats. Steps for creating animation. Softwares for animation.

Video: Basic concepts: Video signal representation, Computer video formats. Video standards: NTSC, PAL, SECAM, HDTV, Video capturing media/instruments. File formats: AVI, MPEG.

Suggested Books:

1. Steinmetz, R., & Nahrstedt, K. (2002). *Multimedia fundamentals, volume 1: media coding and content processing*. Pearson Education.
2. Nahrstedt, K., & Steinmetz, R. (1995). *Multimedia: Computing, Communication & Applications*. New Jersey: Prentice-Hall
3. Vaughan, T. (2006). *Multimedia: Making it work*. Tata McGraw-Hill Education.
4. Andleigh, P. K., & Thakrar, K. (1995). *Multimedia systems design*. Prentice-Hall, Inc.
5. Buford, K., & John, F. (1994). *Multimedia systems*. Addison-Wesley Publishing Co.
6. Desmarais, N. (1994). *Multimedia on the PC: A guide for information professionals*. Tata McGraw Hill

7. Steinmetz, R., & Nahrstedt, K. (2002). *Multimedia: Computing, Communications and Applications: Media Coding and Content Processing*. Prentice Hall PTR.

8. Shuman, J. E. (1998). *Multimedia in action*. International Thomson Publishing Company.

Suggested E-Learning Material:

1. Multimedia processing
   https://nptel.ac.in/courses/117105083/

Reading Electives

CS 404R Client Server Computing and Applications

Max. Marks : 100

L	T	P	C
0	0	0	2

Learning Outcomes:

After successful completion of the course students will be able to

- Understand real life application using client-server architecture.
- Learn concepts of network and its usage in client-server model.
- Design distributed database for various application.

Section A

Evolution of PC, Introduction to Local Area Network, PC LANS, Mainframe Computers, PC Connected to mainframes.

Section B

Distributed Systems and database. Client Server Computing model, Client-Server Hardware and software need, issues in Client Server Computing – shared access, connectivity, security advantages of client server computing. Examples UNIX & Windows NT.

Section C

Client Server Applications: Database Server Networks, Gateways, Video Conferencing and multimedia applications. Client – server architectures: segmentation, switched FDDI, Peer-to-Peer architecture.

Suggested Books:

1. Dewire, D. T. (1993). *Client/server computing*. McGraw-Hill, Inc.

2. Berson, A. (1992). *Client-server architecture*. McGraw-Hill.

3. Orfali, R., Harkey, D., & Edwards, J. (2007). *Client/server survival guide*. John Wiley & Sons.

4. Trivedi, M. & Khanna M. *Client Server Computing*. Book Publishing Co. Pvt. Ltd

CS 444R Parallel Computing

Max. Marks : 100

L	T	P	C
0	0	0	2

Learning Outcomes:

After successful completion of the course students will be able to

- Understand the concepts of parallel computing.
- Learn the basics of pipeline and vector processing.
- Desing various matrix and graph algorithms for parallel processing.
- Understand the concepts of program and data flow computers.

Section A

Introduction to parallel computing, advantages of parallel computing. Solving problems in parallel: Temporal parallelism, Data parallelism and their comparison. Intertask dependency and task graphs. Structures of parallel computers: Pipelined paprallel computers, Array processors, Shared memory multi-processor, message passing multiprocesors, MMC systems. Integer Arithmetic: Carry look-ahead addition and carry-save addition on binary tree, integer multiplication and convolution on a linear array. Elementary sorting algorithm.

Section B

Matrix Algorithms: Matrix-Vector multiplication and solving lower triangular system of equations on a linear array, matrix multiplication, LU decomposition, matrix inversion, Guassian elimination on a mesh.

Graph Algorithms: Mesh algorithm for tranisitive closure, connected component, shortest path, breadth first search and minimum spanning tree. Mesh of trees and its applications such as Matrix-Vector multiplication, Convolution and integer multiplication.

Section C

More fancier networks: r-dimensional mesh of trees, shuffle trees, shuffle-exchange network, hypercube, De-bruijn network and butterfly. Some examples on these networks, sorting and FFT on butterfly.

Introduction to dataflow computers. Parallelism in logic programming. Programming parallel computers.

Suggested Books:

1. Rajaraman, V. (2006). *Elements of parallel computing*. PHI Learning Pvt. Ltd.
2. Quinn, M. J. (1987). *Designing efficient algorithms for parallel computers*. McGraw-Hill.

3. Lakshmivaraha, S., & Dhall, S. K. (1990). *Analysis and design of parallel algorithms: Arithmetic and matrix problems*. McGraw-Hill, Inc.

IT 402R Electronic Commerce

Max. Marks : 100

L	T	P	C
0	0	0	2

Learning Outcomes:

After successful completion of the course students will be able to

- Recognize the business impact and potential of e-Commerce.
- Discuss the current drivers and inhibitors facing the business world in adopting and using e-Commerce.
- Explain the economic consequences of e-Commerce.
- Create and refine ecommerce website and application designs based on industry's usability standards.
- Assess the suitability of various design principles for ecommerce websites and discuss emerging e-commerce topics.

Section A

Whats and hows of Internet: Development and growth, DNS, Commercialisation of internet. Introduction toe~commerce: e-commerce, Opportunities, Framework, Recent Developments. Planning for Network Infrastructure & Web Architecture, Recent trends.

Section B

Introduction to Internet Protocols: Layers and Networking, Internet Protocol suite, Desk topTCP/IP, Mobile TCPIIP based Networking, Multicast IP.

Principles of Web Site Hosting and Promotion: Decision on Website Design, Legal issues, Domain Name Registration, Site Hosting,Web Site Registration, Offline & online web site promotion.

Section C

E-commerce Business Models: Brokerage, Advertising, Infomediary, Merchant, Manufacturer, Affiliate, Community, Subscription, Utility, Tried and True models. Auctions as a price setting mechanism, Pricing Information, Versioning Infonnation: Cyberlaws, Electronic payment systems: Digital cash.

Suggested Books:

1. Turban, E., King, D. R., & Lang, J. (2011). *Introduction to electronic commerce*. Pearson Education.

2. Kalakota, R., & Whinston, A. B. (1996). *Frontiers of e-commerce*. Addison-Wesley.

3. Web Sites (Bababazaar.com, yahoo.com, Indiainfoline.com, buyorbid. com, amazon.com, pitara.com, fabmartcom etc.)

IT 403R Enterprise Resource Planning

Max. Marks : 100	**L**	**T**	**P**	**C**
	0	**0**	**0**	**2**

Learning Outcomes:

After successful completion of the course students will be able to

- Make students able to learn fundamental concepts of ERP system and ERP related technologies.
- Provide students knowledge of different ERP modules and manufacturing perspectives of ERP.
- Use ERP system in different business organizations by having knowledge of latest scenario of ERP market in e-business.

Section A

Introduction to ERP – Predecessors(DSS, MIS, EIS, MRP-I, MRP-II, MRP-III), Origin, Evolution, and Structure; ERP Overview; Reasons for the growth of ERP market, ERP Benefits - Direct and Indirect; Reasons for failure of ERP Implementations; Reasons Organizations should implement ERP; ERP and related Technologies; Business Process Re-Engineering (BPR) - Evolution and different Phases; Data Warehousing - Advantages, Components, Structure, Uses, and Obstacles to successful Data Warehouse Projects; Data Mining - Verification v/s Discovery, Advantages, Technologies used, ; OLAP- 12 rules, OLAP benefits, Introduction to MOLAP, DOLAP, and ROLAP; Supply Chain Management (SCM) - Objectives , Enabling Technologies; Expert System

Section B

ERP – A Manufacturing Perspective — CAD/CAM, MRP-II, BOM, Closed Loop MRP, DRP, JIT & Kanban, PDM (Product Data Management) & its benefits, Data Management, MTO v/s MTS, ATO, ETO, CTO; The Best Practices in ERP; ERP Modules - Finance, Plant Maintenance, Quality Management, Materials Management; ERP Market -SAP AG, BaaN, J D Edwards, Oracle, PeopleSoft; ERP in India

ERP Implementation Life Cycle - Different Phases, Approaches; ERP Implementation - Problems in Implementation; Cost of ERP - The Hidden Costs; Implementation Methodology; Organizing the Implementation; Key Players in Implementation - Vendors, Consultants, Users; Contracts with

Vendors, Consultants, Employees; Project Management & Monitoring; After ERP Implementation; In-house Implementation - Pros & Cons

Section C

The ERP Market - Vendor analysis; Turbo Charge the ERP; Enterprise Integration Applications (EIA); Future Directions in ERP - New Channels, New Markets, Faster Implementation methodologies, Business Models & BAPIs, Web Enabling; ERP & the World Wide Web - E-Commerce, Background, Using ERP though ASP; Making ERP a Success; Critical factors guiding Selection and Evaluation; Strategies for successful Implementation; Impediments & initiatives to achieve success; CSF (Critical Success Factors); Integrating ERP into Organizational Culture; ERP Case Studies

Using ERP Tool: Either SAP or ORACLE formats for Case Study.

Suggested Books:

1. Leon, A. (2014). *Enterprise Resource Planning*. Tata McGraw-Hill.
2. Leon A. (2001).*ERP Demystified*. Tata-McGraw Hill.
3. Monk, E., & Wagner, B. (2012*). Concepts in Enterprise Resource Planning*. Cengage Learning.
4. Altekar, R. V. (2004*). Enterprise wide Resource Planning: Theory and Practice*. PHI Learning.
5. Jacobs, F. R., & Whybark, D. C. (2000). *Why ERP? A Primer on SAP Implementation*. Tata McGraw-Hill.

IT 404R IT in Bussiness

Max. Marks : 100	**L**	**T**	**P**	**C**
	0	**0**	**0**	**2**

Learning Outcomes:

After successful completion of the course students will be able to

- Understand the role of Information Technology in Management.
- Develop strategies for corporate and management secotrs.
- Understand the role of Information Technology in modern industry.

Section A

Business Drivers IT's Competitive Potential.

Strategic Alignment.

Strategic Management and Competitive Strategy.

Incorporating Business Innovation into the Corporate IT Strategy.

Section B

Rethinking Business Through IT Developing a Competitive Strategy Interorganization Information Systems Business–To–Business Systems Electronic Commerce and Market Systems.

Forming a Corporate IT Strategy.

Developing an Information Architecture.

Section C

The Changing Role of IT in International Business.

The Changing Global IT Practices.

The Impact and Value of Information Technology in Competitive Strategy.

Changing the Focus of Strategy.

Trends Beyond 2000.

Suggested Books:

1. Callon, J. D. (1996).*Competitive Advantage Through Information Technology.* McGraw – Hill.
2. Tapscott, D. (1996). *The Digital Economy*. McGraw–Hill.

Online Reading Elective

Agile Software Development

Max. Marks : 100

L	T	P	C
0	0	0	2

Brief Description

This course cuts beyond the agile methodology hype and teaches you the fundamental agile concepts that span a wide range of methodologies. It analyses the key agile ideas, their benefits, their limitations, and how best to take advantage of them to enhance your software skills and show employers that you have mastered an essential component of today's IT industry.

Brief Course outline

- Context, the Agile Manifesto, Agile Methods, Official Agile Principles, Agile Values
- Principles, the enemy: Big Upfront Anything, organizational principles, technical principles, a few method-specific principles
- Roles, traditional manager roles, the three Scrum roles, other Agile roles
- Practices, meetings, development, release, testing, management
- Artifacts, from user stories to burn down charts, assessment on Agile methods

Suggested E-Learning Material:

- Agile Software Development
  https://www.edx.org/course/agile-software-development

Organizational Behavior

Max. Marks : 100

L	T	P	C
0	0	0	2

Brief Description

After studying the course the students will be able to:

- Understand and apply principles of organizational dynamics relating to systems, culture, structure• and change processes
- Develop critical analytical skills that will help them diagnose situations pertaining to human behaviour and generate effective solutions for the same.
- Understand performance behaviour at individual and group levels.
- Develop the ability to lead and motivate others to succeed.

Brief Course Outline

- Introduction to Organizational Behaviour: Concept of Organizational Behaviour (OB), History, Nature and scope of OB, Key elements in OB, Inter-disciplinary contribution to OB, Managerial Roles Individual Behaviour,
- Values & Personality: Concept of Individual Differences, Values commonly studied across culture, Fundamentals and Determinants of Personality, Big Five Dimensions, Personality Theory, Personality Traits
- Learning & Perception : Fundamentals of Learning, Learning Theories - Classical Conditioning Theory, Operant Conditioning Theory, Social Learning Theory, Behaviour Modification, Definition of Perception, Perceptual Process, Common Perceptual Errors
- Motivation : Basic concept of Motivation, Theories of Motivation – Maslow, Herzberg's Two Factor Theory, ERG, McClelland, Equity and Vroom's Expectancy Theory
- Leadership: Introduction, Leadership Theories - Trait Theories, Behavioural Theories and Situational Theories
- Group Dynamics : Defining and classifying groups, Stages of group development, Group Properties – Roles, Norms, Status, Size and Cohesiveness, Group Decision making

- Managing Change in Organization: Definition, Forces of Change, Causes for Resistance to Change, Overcoming Resistance to change, Force Field Analysis and Kotter's Model for Change
- Organizational Culture: Meaning, Strong Culture vs. Weak Culture, Creating & sustaining Culture, Socialization.

Suggested Books:

1. Robbins, S.P.Judge, T.A.•&, Sanghi, Seema. Organizational Behavior, Pearson.
2. Pareek, U, Understanding Organizational Behavior, Oxford University Press.
3. Luthans,F. .Organizational Behaviour, Tata McGraw Hill.
4. Sekaran,U. Organizational Behaviour: Text and Cases, Tata McGraw Hill

Suggested E-Learning Material:

1. https://swayam.gov.in/courses/5148-organizational-behaviour
   https://www.mooc-list.com/course/organizational-behavior-managing-people-coursera

Software as a Service

Max. Marks : 100

L	T	P	C
0	0	0	2

Brief Description

After studying the course the students will be able to:

- Create more sophisticated apps by adding relationships between models in apps and by enhancing their apps with JavaScript.
- Learn about what happens after the apps are deployed to real users, including how to monitor performance, identify and fix common performance problems, and avoid compromising customer data.
- Learn how to apply Agile techniques to enhance and refactor legacy code, a critical skill for professional programmers.

Course Outline:

- How to form, organize and manage small programming teams
- Introduction to design patterns: what they are and how to recognize opportunities to apply them
- Using Rails for more advanced features like third-party authentication and elegantly expressing design patterns that arise frequently in SaaS.

Suggested Books:

1. Engineering Software as a Service (ELLS), Beta edition (0.10.1; 16-April-2013), by Fox and Patterson

Suggested E-Learning Material:

1. https://www.edx.org/course/software-service-uc-berkeleyx-cs-169-2x

Blockchain

Max. Marks : 100

L	T	P	C
0	0	0	2

Brief Description

This course of the Blockchain provides a broad overview of the essential concepts of blockchain technology – by initially exploring the Bitcoin protocol followed by the Ethereum protocol – to lay the foundation necessary for developing applications and programming.

Brief Course Outline

- Basics of Ethereum blockchain, creating accounts, unlocking accounts, concept of miners, transacting, transfer Ethers, and check balances.
- Learning decentralized peer-to-peer network, an immutable distributed ledger and the trust model that defines a blockchain.
- Explanation of the basic components of a blockchain (transaction, block, block header, and the chain) its operations (verification, validation, and consensus model) underlying algorithms, and essentials of trust (hard fork and soft fork).
- Content includes the hashing and cryptography foundations indispensable to blockchain programming, which is the focus of two subsequent specialization courses, Smart Contracts and Decentralized Applications (Dapps).

Suggested E-Learning Material:

1. Blockchain

   https://www.coursera.org/learn/blockchain-basics
