A meeting of **Board of Studies in Computer Science** held on April 30, 2016 at 10.30 a.m. in the conference hall, Vidya Mandir, Banasthali Vidyapith.

Members:
Internal:

1. Prof. G.N. Purohit
2. Prof. Praveen Dhyani
3. Smt. Abha Purohit
4. Shri Ajit Kumar Jain
5. Ms. Anjali Verma
6. Shri Anoop Kumar Bhola
7. Smt. Archana Mangal
8. Shri Ashok Kumar
9. Smt. Bharti Nathani
10. Ms. Chandani Joshi
11. Dr. Chandra Kumar Jha
12. Shri Deepak Kumar
13. Ms. Deepti Chopra
14. Smt. Deepti Goswami
15. Smt. Devershi Pallavi Bhatt
16. Smt. Dipanwita Thakur
17. Dr. Iti Mathur Joshi
18. Smt. Karuna Sharma
19. Shri Khandakar F. Rahman
20. Shri Kuldeep Kumar Yogi
21. Dr. Kusum Gupta
22. Smt. Mainaz Faridi
23. Smt. Manisha Agarwal
24. Smt. Manisha Jailia
25. Shri Manjeet Kumar
26. Ms. Meenakshi Pareek
27. Smt. Monika
28. Ms. Monika Saxena
29. Dr. Neelam Sharma
30. Dr. Nisheeth Joshi
31. Shri Pradeep Kumar Sharma
32. Smt. Parul Raman
33. Ms. Pooja Asopa
34. Dr. Pratistha Mathur
35. Shri Rajeev Singh
36. Smt. Sakshi Pandey
37. Dr. Sanjay Kumar Sharma
38. Dr. Saurabh Mukherjee
39. Dr. Sudha Morwal
40. Shri Vaibhav Vyas
41. Dr. Vikas Pareek
42. Shri Vivek Purohit
43. Shri Yogesh Kumar Gupta
44. Prof. Sarla Pareek
    (Special Invitee)

Prof. Bhushan H. Trivedi, Ahmedabad, Dr. Sunita Agrawal, Allahabad, Smt. Anjali Verma, Shri Manjeet Kumar could not attend the meeting.

The Convener accorded a cordial welcome to all the members present in the meeting.

Agenda -1	Board's Recommendation	
To confirm the minutes of the last meeting of the Board of Studies held on May 5, 2013.	The board confirmed the minutes of its last meeting held on May 5, 2013.	
Agenda -2	**Board's Recommendation**	
To up-date the existing panel of examiners for each examination up to and inclusive of Master's Degree Examination keeping in view of the Bye-law 15.3.02 of the University.	The board reviewed the existing panel of examiners for each examination up to and inclusive of Master's Degree Examination and authorized the Convener to get it revised/updated by a committee of faculty members and submit the updated panel directly to the examination and secrecy section.	
Agenda-3	**Board's Recommendation**	**Page No.**
To review scheme of Examinations **I- B.A./ B.Sc./ BCA Examination:** (i). First Semester Examination, December, 2016 (ii). Second Semester Examination, April/May, 2017 (iii). Third Semester Examination, December, 2017 (iv). Fourth Semester Examination, April/May, 2018 (v). Fifth Semester Examination, December, 2018 (vi). Sixth Semester Examination, April/May, 2019	The board reviewed the scheme of examination, curricula and syllabi of B.A./ B.Sc./ BCA examinations and following changes were suggested in the scheme and syllabi for sessions 2016-17 **(Annexure-I)**. 1. In the scheme of BCA following changes are suggested: **(1) In BCA I Sem.** • Computer Fundamentals and Programming, Pascal has been discontinued and C has been introduced. The existing and proposed syllabus is enclosed. • Laboratory contact hours of Digital Electronics has been reduced from 6 to 4 hours and Laboratory contact hours of C Programming has been increased from 6 to 8 hours. **(2) In BCA II Sem.** • Computer Architecture and Computer Programming paper has been renamed as Computer Architecture and Object Oriented Programming. Instead of Pascal Programming, C++ Programming Language has been introduced. The existing and proposed syllabus is enclosed. • Laboratory Practice II is proposed to be implemented using C++. **(3) In BCA III Sem.** • Data Structures and Programming Methodology paper has been renamed to Data Structures. Here, C Programming has been replaced. The existing and proposed syllabus is enclosed. • Changes in the syllabus of Computer Oriented Numerical and Statistical	**A-I/1-12** **A-I/13-15** **A-I/1** **A-I/16-18** **A-I/2** **A-I/19-21** **A-I/22-25**

	Methods. The existing and proposed syllabus is enclosed.	
	(4) BCA IV Sem.	**A-I/26-29**
	• Changes in the syllabus of Application Software and Visual Computing, Visual Basic has been replaced with VB.Net. The existing and proposed syllabus is enclosed.	
	• Laboratory Practice II is proposed to be implemented using VB.Net.	
	(5) BCA V Sem.	
	• Object Oriented Programming paper has been renamed as Java Programming.	**A-I/5**
	• Changed in the syllabus of Data Base Management System. The existing and proposed syllabus is enclosed.	**A-I/30-32**
	(6) BCA VI Sem.	
	• Changed in the syllabus of Multimedia and Web Designing. The existing and proposed syllabus is enclosed.	**A-I/33-34**
	• Laboratory Practice I is proposed to be implemented using PHP.	
	• Changes in the syllabus of Discrete Mathematics. The existing and proposed syllabus is enclosed.	**A-I/35-36**
	2. In the scheme of B.Sc.(Mathematical Sciences) following changes are suggested:	**A-I/7-9**
	(1) In B.Sc. I Sem.	**A-I/13-15**
	• Computer Fundamentals and Programming, Pascal has been discontinued and C has been introduced. The existing and proposed syllabus is enclosed.	**A-I/7**
	• Laboratory Practice is proposed to be implemented using C.	
	(2) In B.Sc. II Sem.	**A-I/16-18**
	• Computer Architecture and C Programming paper has been renamed as Computer Architecture and Object Oriented Programming. Instead of Pascal Programming, C++ Programming Language has been introduced. The existing and proposed syllabus is enclosed.	**A-I/7**
	• Laboratory Practice is proposed to be implemented using C++.	**A-I/19-21**
	(3) In B.Sc. III Sem.	
	• Data Structures and Object Oriented	

	Programming paper has been renamed to Data Structures. Here, C++ Programming has been replaced. The existing and proposed syllabus is enclosed.	**A-I/8**
	(4) In B.Sc. IV Sem. • BDP & DBMS has been swapped with Computer Oriented Numerical and Statistical Methods of B.Sc. V Sem. • Changes in the syllabus of Computer Oriented Numerical and Statistical Methods. The existing and proposed syllabus is enclosed.	**A-I/8-9** **A-I/22-25** **A-I/10-12**
	(3) In the scheme of B.A.(Computer Application) following changes are suggested: **(1) In B.A. II Sem.** • Computer Programming (Pascal) has been renamed as Computer Programming and Pascal has been replaced with C. The existing and proposed syllabus is enclosed.	**A-I/37-38**
	(2) In B.A. III Sem. • Data Structures and Programming Methodology paper has been renamed to Data Structures. Here, C Programming has been replaced. The existing and proposed syllabus is enclosed.	**A-I/19-21**
	(3) B.A. IV Sem. • Changes in the syllabus of Application Software and Visual Computing, Visual Basic has been replaced with VB.Net. The existing and proposed syllabus is enclosed. • Practical is proposed to be implemented using VB.Net.	**A-I/26-29**
	(4) B.A. VI Sem. • Changes in the syllabus of Multimedia and Web Designing. The existing and proposed syllabus is enclosed. • Laboratory Practice is proposed to be implemented using PHP.	**A-I/33-34**
II- Master of Computer Applications (MCA) Examination: (i). First Semester Examination, December, 2016 (ii). Second Semester Examination, May, 2017 (iii). Third Semester Examination, December, 2016	The board reviewed the scheme of examination, curricula and syllabi of MCA/ /M.Sc.(CS) Examination and the following changes were suggested in the scheme & syllabi **(Annexure II)**: **1.** In the scheme of MCA/ M.Sc. (CS)/ , following changes are suggested:	**A-II/1-6**

(iv). Fourth Semester Examination, May, 2017 (v). Fifth Semester Examination, December, 2017 (vi). Sixth Semester Examination, May, 2018 **Master of Science (Computer Science) Examination:** (i). First Semester Examination, December, 2016 (ii). Second Semester Examination, May, 2017 (iii). Third Semester Examination, December, 2017 (iv). Fourth Semester Examination, May, 2018	**(1) MCA I Sem/ I Sem.** • Changes in the syllabus of Computer Programming. The existing and proposed syllabus is enclosed. • Name of Computer Architecture and Organization has been renamed as Computer Organization and Architecture. • A new paper on Web Technology is introduced. The proposed syllabus is enclosed. • Computer Oriented Numerical & Statistical Methods have been swapped with Discrete Mathematics and its syllabi is proposed with minor changes. The existing and proposed syllabus is enclosed. • System Programming of MCA II Sem. has been brought to I Semester. The existing and proposed syllabus is enclosed. • The committee suggested discontinuing Business Data Processing and Management and Accounting papers. **(2) MCA II Sem.** • The paper Data Structures and Object Oriented Programming is renamed as Data Structures. The existing and proposed syllabus is enclosed. • Changes in the syllabus of Discrete Mathematics. The existing and proposed syllabus is enclosed. • A new paper on Object Oriented Programming is proposed. The syllabus is enclosed. • A new paper on Management Information System is proposed. The syllabus is enclosed. • The committee suggested discontinuing Microprocessor and Microcomputer Applications paper. **(3) MCA III Sem/M.Sc.(CS) I Sem.** • Design and Analysis of Algorithms has been enriched. The existing and proposed syllabus is enclosed. • Changes in the syllabus of Theory of Computation. The existing and proposed syllabus is enclosed. • Software Engineering of MCA IV/ M.Sc.(CS) II Sem. has been brought to MCA III/M.Sc.(CS) I Sem. The syllabus	**A-II/7-9** **A-II/1** **A-II/10** **A-II/2** **A-II/11-12** **A-II/1** **A-II/13-14** **A-II/2** **A-II/16-17** **A-II/17-18** **A-II/2** **A-II/19-20** **A-II/21-22** **A-II/23-24**

	has been enriched. The existing and proposed syllabus is enclosed. • Changes in the syllabus of Operating System. The existing and proposed syllabus is enclosed. • Communication Skills of MCA IV/ M.Sc.(CS) II Sem. has been swapped with Seminar of MCA III/M.Sc.(CS) I Sem. The syllabus has been enriched. The existing and proposed syllabus is enclosed. **(4) MCA IV Sem/M.Sc.(CS) II Sem.** • Modeling and Simulation paper has been shifted to MCA V/M.Sc.(CS) III Sem. as an elective. The existing and proposed syllabus is enclosed. • Distributed Computing has been brought to MCA IV/M.Sc.(CS) II Sem. from MCA V/M.Sc.(CS) III Sem. elective. The existing and proposed syllabus is enclosed. • Compiler Design has been brought from MCA V/M.Sc.(CS) III Sem. **(5) MCA V Sem/M.Sc.(CS) III Sem.** • Changes in the syllabus of Artificial Intelligence. The existing and proposed syllabus is enclosed. • A new paper on Big Data Analytics has been introduced. The proposed syllabus is enclosed. • Elective paper on Pattern Recognition and Image Processing has been renamed as Digital Image Processing. The existing and proposed syllabus is enclosed. • Elective paper on Modeling and Simulation has minor changes. The existing and proposed syllabus is enclosed. • A new elective on Cyber Security is added. Proposed syllabus is enclosed.	**A-II/25-26** **A-II/27-29** **A-II/4** **A-II/30-31** **A-II/4** **A-II/32-34** **A-II/35** **A-II/36-37** **A-II/38**

III-M.Tech. (CS/ IT) examinations (i). First Semester examination, December 2016. (ii). Second Semester examination, May 2017. (iii). Third Semester examination, December 2017. (iv). Forth Semester examination, May 2018.	The Board reviewed the scheme of examination, curricula and syllabi of M.Tech. (CS/ IT) Examinations and no change is suggested in existing scheme (**Annexure-III)**. **1.** The papers of MTech (CS/IT) which are common with MCA will be conducted with the new proposed syllabus as given in **(Annexure-II)** **2.** Changes in the syllabus of "**Advanced Database Management Systems**" paper of M.Tech. (IT), the existing and proposed syllabus is enclosed. **(Annexure-III)**	**A-II/1-39** **A-III/1-3**
V Certificate Examinations: (i). Certificate Course in Computer Programming and Application Examination, 2017. (ii). Certificate Course in IT Localization Examination, 2017.	Resolved to recommend that the existing course of study be continued for the aforesaid examination.	
VI Diploma Examinations: (i). Diploma in Internet and Web Application Examination, 2017. (ii). Diploma in Computer Hardware and Maintenance Examination, 2017. (iii). Diploma in DOTNET(C#, ASP.NET) Examination, 2017. (iv). Diploma in Medical Image Processing, 2017. (v). Advanced Diploma in Networking Examination, 2017.	Resolved to recommend that the existing course of study be continued for the aforesaid examination. The Committee proposed a new course on "Advanced Diploma in Medical Image Processing" to be started from 2016-17. The proposed syllabus and scheme is enclosed. **(Annexure-IV)**	**A-IV/1-3**
Agenda -4	**Board's Recommendation**	**Page No.**
To evaluate the reports received from the examiners of the different examinations and submit a critical report.	The board reviewed the reports received from the examiners of different examinations held in December 2015. The analysis is enclosed. **(Annexure-V)**	**A-V/1**
Agenda -5	**Board's Recommendation**	**Page No.**
To evaluate the question papers of periodical tests and annual examinations keeping in view the following observations of the Vice-Chancellor: "There is a growing concern in many disciplines that quality of question papers has deteriorated over the years. We must evaluate periodicals and final examination papers to	The board reviewed the report of question papers of periodical tests of Jaipur Campus held in 2015-2016. The analysis is enclosed **(Annexure-VI (A)).** The board reviewed the report of question papers of end semester (final) examinations of 2014-15. The analysis is enclosed **(Annexure-VI(B)).**	**A-VI(A)/1-8** **A-VI(B)/1-6**

ascertain to whether this indeed is the case. A comprehensive report on this item will be appreciated showing whether the nature of questions have changed, say from analytic to descriptive, less application oriented, more information based etc. In the end, we need to conclude whether overall the quality of question papers has deteriorated or has not changed."		
Agenda -6	**Board's Recommendation**	**Page No.**
	The Board recommended to coopt the following external members 1. Prof. P.K. Mishra, Professor and Head, Department of Computer Science, Banaras Hindu University, Varanasi (UP), Contact #:0542-2307306, Email: mishra@bhu.ac.in, hd_cs@bhu.ac.in 2. Prof. Sashikala Tapaswi, Professor, Atal Bihari Vajpayee Indian Institute of Information Technology and Management, Gwalior (MP), Contact #: 09165763468, 0751-2449810, Email: stapaswi@iiitm.ac.in	

Annexure II

EXISTING (2015-16)

MCA SEMESTER I

	Paper	Cont. Hrs/ Week		Cont. Ass. Marks		Ann. Ass. Marks		Total Marks		Min. Pass Marks	
		T	P	T	P	T	P	T	P	T	P
1	Computer Programming	4	8*	20	20	40	40	60	60	22	22
2	Computer Architecture & Organization	4	0	20	0	40	0	60	-	22	-
~~3~~	~~Management and Accounting~~	~~4~~	~~0~~	~~20~~	~~0~~	~~40~~	~~0~~	~~60~~		~~22~~	
4	Discrete Mathematics	4	0	20	0	40	0	60		22	
~~5~~	~~Business Data Processing~~	~~4~~	~~4**~~	~~20~~	~~10~~	~~40~~	~~20~~	~~60~~	~~30~~	~~22~~	~~11~~
	Total	20	12	100	30	200	60	300	90		390

~~* ***Programming in C***~~

** ~~***Programming in COBOL***~~

PROPOSED (2016-17)

MCA SEMESTER I

	Paper	Cont. Hrs/ Week		Cont. Ass. Marks		Ann. Ass. Marks		Total Marks		Min. Pass Marks	
		T	P	T	P	T	P	T	P	T	P
1	Computer Programming*	4	6*	20	15	40	30	60	45	22	18
2	Computer Organization & Architecture	4	0	20	0	40	0	60	-	22	-
3	Introduction to Web Designing	4	4*	20	10	40	20	60	30	22	11
4	Computer Oriented Numerical & Statistical Methods$	4	2*	20	5	40	10	60	15	22	5
5	Systems Programming	4	0	20		40	0	60	-	22	-
	Total	**20**	**12**	**100**	**30**	**200**	**60**	**300**	**90**		**390**

* **Computer Programming Lab (C language in GCC & Windows/Unix/Linux compiler only.**

$ Computer Oriented Numerical & Statistical Methods Lab('C' language)

EXISTING (2015-16)

MCA SEMESTER II

	Paper	Cont. Hrs/Week		Exam. Duration	Cont. Ass. Marks		Ann. Ass. Marks		Total Marks		Min. Pass Marks	
		T	P		T	P	T	P	T	P	T	P
1	Data Structure & Object Oriented Programming	4	6*	3 hrs.	20	15	40	30	60	45	22	16
2	Microprocessor & Microcomputer Applications	4	0	3 hrs.	20	0	40	0	60	-	22	
3	Computer Oriented Numerical & Statistical Methods	4	2*	3 hrs.	20	5	40	10	60	15	22	5
4	System Programming	4	0	3 hrs.	20	0	40	0	60	0	22	
5	Database Management System	4	4***	3 hrs.	20	10	40	20	60	30	22	11
	Total	20	12		100	30	200	60	300	90		390

* ~~***Implementation of Data Structures in 'C'/ C++, Programming in C++***~~

** ~~***Implementation of Computer Oriented Numerical Algorithms & Statistical Methods in 'C'***~~

*** ~~***DBMS lab using Oracle DB2***~~

PROPOSED (2016-17)

MCA SEMESTER II

	Paper	Cont. Hrs/Week		Exam. Duration	Cont. Ass. Marks		Ann. Ass. Marks		Total Marks		Min. Pass Marks	
		T	P		T	P	T	P	T	P	T	P
1	Data Structures	4	4*	3 hrs.	20	10	40	20	60	30	22	16
2	Management Information System	4	0	3 hrs.	20	0	40	0	60	-	22	
3	Discrete Mathematics	4	0	3 hrs.	20	0	40	0	60	-	22	-
4	Object Oriented Programming	4	4**	3 hrs.	20	10	40	20	60	30	22	11
5	Database Management System	4	4#	3 hrs.	20	10	40	20	60	30	22	11
	Total	**20**	**12**		**100**	**30**	**200**	**60**	**300**	**90**		**390**

* **Data Structures Lab (C)**

** **Object Oriented Programming Lab (C++)**

\# **Database Management Lab (Oracle/ DB2)**

EXISTING (2015-16)

MCA SEMESTER III/ M.SC. (COMPUTER SCIENCE) SEMESTER I

	Paper	Cont. Hrs/Week		Exam. Duration	Cont. Ass. Marks		Ann. Ass. Marks		Total Marks		Min. Pass Marks	
		T	P		T	P	T	P	T	P	T	P
1	Design & Analysis of Algorithm	4	4*	3 hrs.	20	10	40	20	60	30	22	16
2	Java Programming	4	4*	3 hrs.	20	10	40	20	60	30	22	
3	Theory of Computation	4		3 hrs.	20	0	40	0	60	0	22	5
4	Operating System	4	2***	3 hrs.	20	5	40	10	60	15	22	
~~5~~	~~SAD & MIS~~	~~4~~		~~3 hrs.~~	~~20~~	~~0~~	~~40~~	~~0~~	~~60~~	~~0~~	~~22~~	~~11~~
6	Seminar	0	2	-	0	15	0	0		15		
	Total	20	12		100	40	200	50	300	90		390

* ~~*Algorithms in 'C'/ C++ /Java*~~ ** ~~*Programming in Java*~~

*** ~~*Unix Shell Programming*~~

PROPOSED (2016-17)

MCA SEMESTER III/ M.SC. (COMPUTER SCIENCE) SEMESTER I

	Paper	Cont. Hrs/Week		Exam. Duration	Cont. Ass. Marks		Ann. Ass. Marks		Total Marks		Min. Pass Marks	
		T	P		T	P	T	P	T	P	T	P
1	Advanced Data Structures and Algorithms	4	4*	3 hrs.	20	10	40	20	60	30	22	16
2	Java Programming	4	4**	3 hrs.	20	10	40	20	60	30	22	
3	Theory of Computation	4	0	3 hrs.	20	0	40	0	60	-	22	-
4	Operating Systems	4	2***	3 hrs.	20	5	40	10	60	15	22	11
5	Software Engineering	4	0	3 hrs.	20	0	40	0	60	0	22	-
6	Communication Skills	2	0	2 hrs.	5	0	20	0	30	-	22	-
	Total	22	10		105	25	220	50	330	75	405	

* **Advanced Data Structures and Algorithms (C/C++)**

** **Java Programming Lab (Java)**

*** **Operating systems Lab (Unix/Linux)**

EXISTING (2015-16)

MCA SEMESTER IV/ M.SC. (COMPUTER SCIENCE) SEMESTER I

	Paper	Cont. Hrs/Week		Exam. Duration	Cont. Ass. Marks		Ann. Ass. Marks		Total Marks		Min. Pass Marks	
		T	P		T	P	T	P	T	P	T	P
1	Web Development & .NET Framework	4	8*	3 hrs.	20	20	40	40	60	60	22	22
2	Modeling & Simulation	4	0	3 hrs.	20	0	40	0	60	0	22	
3	Software Engineering	4	0	3 hrs.	20	0	40	0	60	0	22	
4	Data Communication & Netwaorks	4	0	3 hrs.	20	0	40	0	60	0	22	
5	Project	0	8**	3 hrs.	0	20	0	40	0	60	22	22
6	Communication Skills	2	0	2 hrs.	10	0	20	0	30	0		11
	Total	18	16		90	40	180	80	270	120		390

* ***Programming in ASP.NET using C# and VB.NET***

** ***Software Project – Design and Development using Software Engineering Techniques***

PROPOSED (2016-17)

MCA SEMESTER IV/ M.SC. (COMPUTER SCIENCE) SEMESTER II

	Paper	Cont. Hrs/Week		Exam. Duration	Cont. Ass. Marks		Ann. Ass. Marks		Total Marks		Min. Pass Marks	
		T	P		T	P	T	P	T	P	T	P
1	Web Development & .NET Framework	4	8*	3 hrs.	20	20	40	40	60	60	22	22
2	Distributed Computing	4	0	3 hrs.	20	0	40	0	60	-	22	-
3	Compiler Design	4	0	3 hrs.	20	0	40	0	60	-	22	-
4	Data Communications & Networks	4	0	3 hrs.	20	0	40	0	60	-	22	-
5	Project	0	8**	3 hrs.	0	20	0	40	0	60	22	22
6	Seminar	0	2	-		15	0	0		15		
	Total	16	18		80	55	160	80	240	135		375

* ***Programming in ASP.NET using C#***

** **Project (Design and Development using Software Engineering Techniques)**

EXISTING (2015-16)
MCA SEMESTER V/ M.SC. (COMPUTER SCIENCE) SEMESTER III

	Paper	Cont. Hrs/Week		Exam. Duration	Cont. Ass. Marks		Ann. Ass. Marks		Total Marks		Min. Pass Marks	
		T	P		T	P	T	P	T	P	T	P
1	Computer Graphics	4	8*	3 hrs.	20	20	40	40	60	60	22	22
2	Artificial Intelligence	4	4**	3 hrs.	20	10	40	20	60	30	22	11
3	Compiler Design	4	0	3 hrs.	20	0	40	0	60	0	22	
4	Elective I	4	0	3 hrs.	20	0	40	0	60	0	22	
5	Elective II	4	0	3 hrs.	20	0	40	0	60	0	22	
	Total	20			100	30	200	60	300	90		390

*~~***Implementation of Computer Graphics Problems in 'C'/ C++/ Java***~~
~~*Emplementation of At problems in Prolog***~~

(Elective I & Elective II should be selected from different Elective Groups)

PROPOSED (2017-18)
MCA SEMESTER V/ M.SC. (COMPUTER SCIENCE) SEMESTER III- (2018-19)

Paper		Cont. Hrs/Week		Exam. Duration	Cont. Ass. Marks		Ann. Ass. Marks		Total Marks		Min. Pass Marks	
		T	P		T	P	T	P	T	P	T	P
1	Computer Graphics	4	8*	3 hrs.	20	20	40	40	60	60	22	22
2	Artificial Intelligence	4	0	3 hrs.	20	0	40	0	60	0	22	11
3	Big Data Analytics	4	4**	3 hrs.	20	10	40	20	60	30	22	11
4	Elective I	4	0	3 hrs.	20	0	40	0	60	-	22	-
5	Elective II	4	0	3 hrs.	20	0	40	0	60	-	22	-
	Total	20	12		100	30	200	60	300	90		390

* ***Implementation of Computer Graphics Problems in 'C'/ C++/ Java***
** **Big Data Analytics Lab in Hadoop**

(Elective I & Elective II should be selected from different Elective Groups)

Group – I
1. Cyber Security
2. Mobile Computing
3. Data Mining and Ware Housing
4. Real Time System

Group – II
1. Soft Computing
2. Modeling and Simulation
3. Digital Image Processing
4. Cloud Computing

EXISTING (2015-16)
MCA SEMESTER VI/ M.SC. (COMPUTER SCIENCE) SEMESTER IV

Marks Distribution Part I		Marks
i.	Project Proforma	10
ii.	Quality of work	25
iii.	Midterm & End Evaluation from their respective guide	30
Part II		
i.	Synopsis	25
ii.	Total A (Continuous Assessment)	90
Part III		
i.	Dissertation & Project	75
ii.	Interim Report	25
iii.	Seminar	40
iv.	Viva-Voce	40
	Total B	180
	Total (A+B)	270
	Reading Elective:	30
Total		300

MCA
Grand Total = 390 (Semester I) + 390 (Semester II) + 390 (Semester III) + 390 (Semester IV) = 390 (Semester V) + 300 (Semester VI) = 2250

M.Sc. (CS)
Grand Total = 390 (Semester I) + 390 (Semester II) + 390 (Semester III) + 300 (Semester IV) = 1470

PROPOSED (2017-18)
MCA SEMESTER VI/ M.SC. (COMPUTER SCIENCE) SEMESTER IV (2018-19)

Marks Distribution Part I		Marks
i.	Project Proforma	10
ii.	Quality of work	20
iii.	Midterm & End Evaluation from their respective guide	25
Part II		
i.	Synopsis	20
	Total I + Part II (Continuous Assessment)	**75**
Part III		
i.	Dissertation & Project	85
ii.	Seminar	50
iii.	Viva-Voce	60
iv.	Total B	195
	Total I + II + III	**270**
	Reading Elective:	30
Total		**300**

MCA
Grand Total = 390 (Semester I) **+ 390** (Semester II) **+ 405** (Semester III) **+ 375** (Semester IV) **= 390** (Semester V) **+ 300** (Semester VI) **= 2250**

M.Sc. (CS)
Grand Total = 405 (Semester I) + 375 (Semester II) + 390 (Semester III) + 300 (Semester IV) = 1470

MCA I SEM.

Computer Programming

Contact hours: 60

Section	Existing Syllabus (20154-16)	Proposed Syllabus (2016-17)	Remarks/ Justification
Title	**Computer Programming**	**Computer Programming**	
Objective	• Learning fundamentals of computer systems and operating system. • Developing good programming skills using algorithms and flowcharts. • Coding programs in 'C' using data types, control structures, functions arrays and pointers. • Demonstrate the ability to run, test, and debug 'C' programs.	• Learning fundamentals of computer systems and operating system. • Developing good programming skills using algorithms and flowcharts. • Coding programs in 'C' using data types, control structures, functions arrays, pointers, and file handling. • Demonstrate the ability to run, test, and debug 'C' programs.	
Section-A	Simple Model of a Computer System : CPU, Memory, Input/Output Devices. Hardware and Software, Booting Process and Dos Command. Steps Involved in computer programming, problem analysis, algorithms & flow charts. Computer programming (in C) : Various data types (simple and structured) and their representation, constants and variable, arithmetic's and logical expressions, ~~data assignment,~~ input and output statement. High level and low level programming language.	**Fundamentals of Computer System:** Block Diagram, CPU, Memory, Input/Output Devices. Hardware and Software, Booting Process and DOS Commands. **Steps in Program Development:** Problem analysis, algorithms & flow charts, High level and low level programming languages, **Computer Programming Using C:** History, Data types (simple and structured) and their representation, Constants and variables, Operators, Arithmetic's and logical expressions, Type casting, Input and output statements.	Restructuring of Section
Section – B	C Programming : Control statement- sequencing, conditional and unconditional branching and looping. Single and multi-dimensional arrays. Searching (Linear, binary), sorting (bubble, selection and insertion) and merging.	**Control Statements:** Sequencing, Conditional and unconditional branching and looping. **Arrays:** Single and multidimensional arrays, Arrays and strings, String built-in functions, Applications of arrays: Searching (linear and binary), Sorting (bubble, selection	1. Restructuring of Section 2. **Shadowed Text:** Shifted from Section

		and insertion). **Structured Programming:** Function declaration and definition, Function call, Passing parameters to the functions: call by value, call by reference. Returning values, Recursive functions, Passing arrays to functions.	C and Elaborated
Section – C	Pointer, address arithmetic, Function, Parameter passing, recursion. Dynamic memory allocation. Structure and union, file handling, command line arguments.	**Storage classes in C:** Automatic, Register, External, and Static. **Pointers:** Pointer arithmetic, Pointers and arrays, Pointers and strings, Pointer to pointer, Dynamic Memory Allocation. **Derived Data Types:** Structures, unions, Array of structure, Pointer to structure, enumerated data types. **File Handling in C:** Types of files, Opening and closing a data file, reading and writing a data file, Random access in a file, Error handling during file I/O operations, Command line arguments.	1. Restructuring of Section 2. **Shadowed Text:** Elaborated 3**. Underlined Text:** Newly Added
	Text Books: 1. Kanetkar,Yashavant P., Let us C, BPB Publication, 2009 2. Sinha,P. K., Computer fundamentals : concept, systems and application, BPB 2004 **Reference Books:** 1. Kernighan, Brain W., The C programming language, Prentice – Hall 1988 2. Kanetkar, Yashavant P., Understanding pointers in C, BPB Publications 2009 3. Dromey, R. G., How to solve it by computer, Prentice- Hall 2007 4. Govil, Mahesh Chand, Computer fundamentals and programming in C, Jaipur Pub. House 5. NIIT, Introduction to computer programming, Prentice-Hall 2005 6. Venugopal, K. R., Programming with C, Tata	**Text Books:** 1. Kanetkar,Yashavant P., Let us C, BPB Publication, 2009 2. Sinha,P. K., Computer fundamentals : Concept, Systems and Application, BPB 2004 **Reference Books:** 1. Kernighan, Brain W., The C programming language, Prentice – Hall 1988 2. Kanetkar, Yashavant P., Understanding pointers in C, BPB Publications 2009 3. Dromey, R. G., How to solve it by computer, Prentice- Hall 2007 4. Govil, Mahesh Chand, Computer fundamentals and programming in C, Jaipur Pub. House 5. NIIT, Introduction to computer programming, Prentice-Hall 2005 6. Venugopal, K. R., Programming with C, Tata	

	Mcgraw Hill 2005 7. Balagurusamy, E., Programming in ANSI C, Tata McGraw-Hill 2010	Mcgraw Hill 2005 7. Balagurusamy, E., Programming in ANSI C, Tata McGraw-Hill 2010	

Proposed
MCA I Sem
Introduction to Web Designing

Maximum Mark: 40
Exam Duration: 3 Hour **Schedule Classes: 60**

Course Objectives:

- To enable the students to learn the concept of Internet and its relevance in organizational functioning.
- Introducing the design principles and techniques of web site design.
- To familiarize the students with Web Design and Development Process using Web Languages (like HTML, JavaScript, PHP etc.).

SECTION A

Internet: Concept of Networking, Applications, Evolution of Internet, Basic Internet services, WWW, Concept of Web browser, Web server, Domain Name Server (DNS), URL, HTTP, Internet Service Providers, Search engines, Cookies, Basics of Web site design, Characteristics of a good website , Web hosting and Web publishing, Web crawlers, Introduction to Web Design Tools (Front page, Dreamweaver).
HTML: Introduction, Elements, Structure of HTML code, Attributes, Headings, Paragraphs, Styles, Formatting, Lists, Quotations, Links, Images, Tables, Forms, Frame, DHTML.

SECTION B

Cascading Style Sheets (CSS): Syntax, Internal, External and Embedded CSS. CSS: Text, Fonts, Links, Tables, Border, Outline, Margin, Class Selector, ID Selector.
JavaScript: Introduction, Syntax, Data types, Variables, Expressions, Operators, Conditional statements, Looping structures: while, do while, for. Arrays, Functions, Forms and validations, Event Handling, DOM of JavaScript, JavaScript objects.

SECTION C

PHP Introduction: Origin, PHP with the Web Server, Pros and Cons, syntax, data types, variables, constant, expression, operator, Control structure, Loops, Functions, argument passing in functions, References, Pass by Value & Pass by references, Return Values, Variable Scope, Array, Form handling, String handling, Cookies and Sessions, Basics of MySql, Connectivity with MySql.

Recommended Books:

1. Deborah S. Roy, Eric J. Roy , "Mastering HTML 4.0", BPB Publication.
2. Ivan Bayross, "Web Enabled Commercial Applications Development Using HTML, DHTML and PHP" Ivan Bayross, 4th Edition, BPB Publication.
3. Steven Holzner , "PHP: The Complete Reference ", McGraw-Hill, 2008.
4. P.J. Deitel & H.M. Deitel, "Internet and World Wide Web How to Program", Pearson Education.
5. Raymond Greenlaw, Ellen Hepp, "Fundamentals of Internet and the World Wide Web", McGraw-Hill Higher Education; 2nd Edition .

MCA I Sem

System Programming

Contact hours: 60

Section	Existing Syllabus (20154-16)	Proposed Syllabus (2016-17)	Remarks/ Justification
Title	**Computer Programming**	**Computer Programming**	
Objectives:	• To introduce various system softwares and design of them. • To give idea of assembler and its design including phases of compilers. • To introduce different types of loading schemes. • To have a idea of system software tools. • To introduce access to system services	• To introduce various system softwares and design of them. • To give idea of assembler and its design including phases of compilers. • To introduce different types of loading schemes. • To have a idea of system software tools. • To introduce access to system services	No Change
Section-A	Components of System software, Evolution of System software, General Machine Structure (Memory, Instructions, Registers), Assemblers, Design of 2 pass assembler, Macros and macro processors, translators, interpreters, brief description of different phases of compiler.	System Software: Components and Evolution. General Machine Structure: Memory,Instructions, Registers Operating Systems: Types & basic functions. Assemblers: Elements of Assembly Language Programming, A Simple Assembly Scheme, Pass Structure of Assemblers, Design of 2 pass assembler	shifted from Unit-B
Section – B	Loaders: A 2 pass loader scheme, relocating loader, subroutine linkage, direct linking loader, binders, overlays, types and basic functions of operating systems, software tools: text editors, program generator, debug monitors.	***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).***	Shifted from Unit-A
Section – C	Access to system services: ROM BIOS, DOS, Mouse and EMS(Expanded memory specification) functions, keyboard and screen management, introduction to terminal emulator, dos device drivers: types, structure and processing. Interrupt types, organization, interrupt hardware, program status register (PSR), interrupt processing	Software Tools: Editors, Debug Monitors, Program generators Translators: Interpreters, Compiler: Brief description of different phases. ROM BIOS, EMS, input and output services. Device Drives: Types, structure and processing. Interrupt: Types, Organization, processing, IVT, interrupt handler.	Shifted from Unit-B Unnecessary portion from Unit-C deleted

	Text Books: 1. Donovan J.J, Systems programming, Tata Mc-Graw Hill, 1991. 2. Dunkan R, Advance MS-DOS programming, BPB Publication, 1994. **Reference Books:** 1. Elzeey Roy S., Computer System Software, Science Research Associates, 1987. 2. Dhamdhere D.M., Introduction to system software, Tata Mc-Graw Hill, 1987. 3. Bigger Staff T. J, System Software Tools, Prentice Hall, 1986. 4. Dhamdhere D.M, System Programming and Operating Systems, Tata Mc-Graw Hill, 2nd edition, 2001. 5. Bose S.K., Hardware and Software of Personal Computers, New Age international Publishers, 1991.	**Text Books:** 1. Donovan J.J, Systems programming, Tata Mc-Graw Hill, 1991. 2. Dunkan R, Advance MS-DOS programming, BPB Publication, 1994. **Reference Books:** 1. Elzeey Roy S., Computer System Software, Science Research Associates, 1987. 2. Dhamdhere D.M., Introduction to system software, Tata Mc-Graw Hill, 1987. 3. Bigger Staff T. J, System Software Tools, Prentice Hall, 1986. 4. Dhamdhere D.M, System Programming and Operating Systems, Tata Mc-Graw Hill, 2nd edition, 2001. 5. Bose S.K., Hardware and Software of Personal Computers, New Age international Publishers, 1991.	

MCA II SEM. (Paper Code: 2.1)

Data Structures

Contact Hrs: 3 Hrs. Contact Hrs : 60

Section	Existing Syllabus (2014-15)	Proposed Syllabus (2015-16)	Remarks/Justification
Title	**Data Structures and Object Oriented Programming**	**Data Structures**	
Objectives :	• To analyze time and space complexity of simple algorithm. • To understand the representation, implementation and applications of basic data structures stacks, queues and trees. • To understand Object Oriented Design principles through C++.	• To analyze time and space complexity of simple algorithm. • To understand the representation, implementation and applications of basic data structures stacks, queues and trees.	
Section-A	Data structures, Abstract data type, Running time of a program. List processing: Linear data structures, linked lists, implementation of singly, doubly & circular linked list, static and dynamic implementation of stacks and queues, recursive and non recursive procedure using stack, simple applications.	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.	Topics in Section-A and B of the existing syllabus have been redistributed over Section-A, B and C of the proposed syllabus. Shaded Portion is added for enriching DS by introducing Searching and Sorting Techniques.
Section-B	Non linear data structures : trees, basic terminology, binary tree, binary search tree and their implementation, implementation of various operations on Binary Search Tree (tree traversal, searching, insertion and deletion), ~~balanced tree, application of tree.~~	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	Shaded Portion is added for enriching Section II

		collection.	
Section-C	~~Concepts of Object oriented Programming, objects and classes, constructors and destructors, data encapsulation, polymorphism, operator overloading and function overloading dynamic binding, Inheritance. Other characteristics : Pointer to objects, virtual functions, friend function, static function, this pointer, and templates.~~	**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).	Topics in Section-C of the previous paper will be covered as a separate paper on object oriented programming.
Text / reference book	**Text Books:** 1. Tremblay, Jean-Paul, **An Introduction to data structures with applications**, 2nd edition, Tata McGraw-Hill, 1991. 2. Venugopal, K. R. **Mastering C++.** Tata McGraw-Hill, 1997 **Reference Books:** 1. Aho, Alfred V., **Data structures and algorithms**, Pearson Education, 1983. 2. Berman, A. Michael, **Data structures via C++** objects by evolution, Oxford University Press. 3. Lipschutz, Seymour, Schaum's outline of **theory and problems of data structures**, McGraw-Hill. 4. Rowe, Glenn W., **Introduction to data structures and algorithms with C++,** Prentice-Hall, 1997 5. Balagurusamy, E. **Object-Oriented Programming with C++,** 4th ed. Tata McGraw-Hill, 2008	**Text Book:** [1] A.M. Tanenbaum: **Data structure using C & C++, :** Prentice Hall of India **Reference Books:** [1] Tremblay Jean-Paul & Sorenson P.G,: **An Introduction to Data Structures with Application:** Mc. Graw Hill, 1985 [2] Horowitz E. and S. Sahni: **Fundamentals of data structures:** University Press, 2009. [3] A.V. Aho, J.E. Hopecraft & J.D. Ullman: **Data structure and Algorithms: Addition** –Wesley Publishing Co., 1987 [4] Lipschutz, Seymour, Schaum's outline of **theory and problems of data structures**, McGraw-Hill.	

Proposed
MCA Semester II
December 2016 – April 2017

Object Oriented Programming

Contact Hours: 60

Objectives:

- To attain a good conceptual and application oriented understanding of Object Oriented Programming
- To develop ability to solving various real-world problems using C++.

Section A

Object-Oriented Methodology: Differences from Functional Methodology, Abstraction, Encapsulation, Object Modeling Technique, Objects, Classes, Object Diagrams, Attributes, Operations and Methods, Links, Associations, Multiplicity, Generalization and Inheritance, Aggregation, Abstract Classes, Multiple Inheritance

C++: Tokens, Data Types, Operators and Expressions, Promotion and Type Conversion, Operator Precedence and Associativity, Conditional and Looping Constructs, Operations on Arrays, Strings Manipulations, Function Components, Parameter Passing, Return by Reference, Default Arguments, Inline Functions, Function Overloading, Arrays and Functions, Scope and Extent of Variables, Storage Classes, Functions with Variable Number of Arguments, Recursive Functions, Class Specification, Class Objects, Data Hiding, Empty Classes, Passing Objects as Arguments, Returning Objects from Functions

Section B

Friend Functions and Friend Classes, Constant Parameters and Member Functions, Static Data and Member Functions, Constructors, Destructor, Constructor Overloading, Constructors with Default Arguments, Nameless Objects, Dynamic Initialization through Constructors, Copy Constructor, Constant Objects and Constructor, Static Data Members with Constructors and Destructors, Pointers and their Binding, void Pointers, Runtime Memory Management, Pointer Constants, Pointers to Constant Objects, Constant Pointer, Pointers to Objects, Live Objects, Array of Objects, this Pointer, Unary Operator Overloading, Increment/ Decrement Operators, Binary Operator Overloading, Arithmetic Operators, Concatenation of Strings, Comparison Operators, Arithmetic Assignment Operators, Overloading of new and delete Operators, Data Conversion, Overloading with Friend Functions, Assignment Operator Overloading, Inheritance and Member Accessibility, Constructors and Destructors in Derived Classes, Constructors Invocation and Data Member Initialization, Overloaded Member Functions, Abstract Classes, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Multipath Inheritance and Virtual Base Classes, Hybrid Inheritance

Section C

Virtual Functions, Pointer to Derived Class Objects, Pure Virtual Functions, Abstract Classes, Dynamic Binding Implementation, Function Templates, Overloaded Function Templates, Nesting of Function Calls, Multiple Arguments Function Template, User Defined Template Arguments, Class Templates, Inheritance of Class Template, Class Template Containership, Class Template with Overloaded Operators, Console I/O, Concept of Streams, Hierarchy of Console Stream Classes, Unformatted and Formatted I/O Operation, Managing Output with Manipulators, File Handling, Classes for File Stream Operation, Open and Close a File, File Models, File Pointers and their Manipulations, Sequential I/O Operations, Updating a File, Error Handling during File Operation, Exception Handling, Use of Standard Template Library (STL)

Text Books:

1. Rumbaugh, James, Blaha, Michael, Premerlani, William, Eddy, Frederick, Lorensen, William. *Object-Oriented Modeling and Design*, New Delhi: Prentice-Hall of India Private Limited, 1991
2. Venugopal, K.R., Buyya, Rajkumar, Ravishankar, T. *Mastering C++*, New Delhi: Tata Mc-Graw Hill Publishing Company Limited, 1997

Reference Books:

1. Schildt, Herbert. *C++: The Complete Reference*, New Delhi: Tata Mc-Graw Hill Publishing Company Limited, 2001
2. Balagurusamy, E. *Object Oriented Programming with C++*, 4th ed. New Delhi: Tata Mc-Graw Hill Publishing Company Limited, 2008
3. Kanetkar, Yashavant P. *Let Us C++*, New Delhi: BPB Publications, 1999

Proposed
MCA Semester II
December 2016 – April 2017

Management Information System

Contact Hours: 60

Objectives:

- Understanding basic managerial concepts and their application in achieving high performance.
- Understanding the framework and fundamentals of organizational behavior as the basis for building and sustaining high performance and effectiveness.
- Analyze and apply different concepts related to leadership, decision making, motivation, managing conflict, stress, and communication.
- Develop familiarity with cost accounting and its application in business.

Section A

Introduction to management, Evolution of management, (Scientific Management – F.W. Taylor, Administration Management – Henry Fayol, Human Relation – Elton Mayo, System Approach) Functions of management, Overview of contemporary challenges : Global management, Workforce diversity, Corporate, Social responsibility.

Section B

International Management Information System: Definition and Characteristics,Components of MIS, Framework of understanding MIS: Robert Anthony's, Hierarchy of Management Activity.
Information requirements and Levels of Management.

The new strategic role of Information systems , methodologies for evaluating investments in IT , Framework and methodologies should be discussed and illustrated with Case Studies, Critical success factor in implementing IT applications, Study of successful / failed IT projects. Critical role of security in implementing IT application.

Section C

Decision Support System: Overview, components and classification, steps in constructing a DSS, role in business, group decision support system, integration and implementation of DSS, Information system for strategic advantage, strategic role for information system, reengineering business process, improving business Qualities, Marketing Information system, Manufacturing IS, financial information system

Text and Reference Books:

1. MIS 2/e by Sadagopan , EEE , PHI Publication .
2. Using MIS by David M Kroenke , Prentice Hall , 2016

3. MIS Cases by Miller Lisa, 3/e Pearson Education.
4. Management Information System , Tenth edition, Pearson Education.
5. Stephen P.Robbins and Mary Coulter , Management,10/e Printice Hall India,2010.
6. Koontz Harold and Weihrich Heinz, Essential of Management, 8th ed, McGraw Hill, 2010.

MCA III/M.Sc I Semester

3.1: Design and Analysis of Algorithms **Contact hours: 60**

Section	Existing Syllabus (2015-16)	Proposed Syllabus (2016-17)	Remarks/ Justification
Title	**Design and Analysis of Algorithms**	**Design and Analysis of Algorithms**	
Sec A	Analysis of an algorithm, Time and Space complexity, Asymptotic notation to represent the complexity. Advance Data Structures: Threaded Tree, B-Tree, Heap and Heap Sort, Sets and Union, Hashing, Graphs. Basic Search & Traversal Techniques: Breadth First and Depth First Traversal of Graph,	Analysis of an algorithm, Time and Space complexity, Asymptotic notation to represent complexity of an algorithm, Recurrences-substitution method, iteration method and master method. Advance Data Structures: Threaded Tree, B-Tree, Heap and Heap Sort, Union and Find operations on Disjoint Set, Hashing, Representation of Graph and Breadth First & Depth First Traversal of Graph.	
Sec B	Divide and Conquer: Binary Search, Merge Sort, Quick Sort, and Matrix Multiplication. Greedy Method: General Method, Knapsack Problem, Job Sequencing with Deadlines, Optimal Merge Patterns, Minimum Spanning Tree, Single Source Shortest Paths. Dynamic Programming: [~~***General Search Tree***~~], 0/1 Knapsack Problem, Traveling Salesman Problem	***Divide and Conquer***: General method, Max-Min, Binary Search, Merge Sort, Quick Sort, and Matrix Multiplication. ***Greedy Technique***: General Method, Knapsack Problem, Job Sequencing, Optimal Merge Patterns, Minimum Spanning Tree, Single Source Shortest Path. ***Dynamic Programming***: General Method, 0/1 Knapsack Problem, Traveling Salesman Problem.	General method and Max-Min added, General Search Tree replaced with general method of dynamic programming**.**
Sec C	Backtracking: General Method, N Queen Problem, Sum of Subsets Problem, Graph Coloring Problem, 0/1 Knapsack Problem. Branch and Bound: General Method, 0/1 Knapsack Problem, Traveling Salesman Problem, ~~***[Efficiency Consideration].***~~ NP Hard & NP Complete Problems: Basic Concepts, Deterministic & Non Deterministic Polynomial Time Algorithms, Tractability, [~~***Cook's Theorem***~~] and Examples of NP Hard & NP Complete Problems.	***Backtracking***: General Method, N Queen Problem, Sum of Subsets Problem, Graph Coloring Problem, 0/1 Knapsack Problem. ***Branch and Bound***: General Method, 0/1 Knapsack Problem, Traveling Salesman Problem, NP Hard & NP Complete Problems: Basic Concepts, Deterministic & Non Deterministic Polynomial Time Algorithms, Tractability, Examples of NP Hard & NP Complete Problems.	**Efficiency consideration is removed.**

	Text Book : [1] E. Horowitz, S. Sahni: **Fundamentals of Computer Algorithms** **Reference Books :** [2] V. Aho, J. E. Hopcroft, & J.D. Ullman: **Design & Analysis of Computer Algorithms** [3] P.Berlions & P. Bizard: **Algorithms - The Construction, Proof & Analysis of Programs** [4] K. Melhorn: **Data Strucures and Algorithms, Vol. I & II**	**Text Book :** [1] E. Horowitz, S. Sahni: **Fundamentals of Computer Algorithms** **Reference Books :** [2] V. Aho, J. E. Hopcroft, & J.D. Ullman: **Design & Analysis of Computer Algorithms** [3] P.Berlions & P. Bizard: **Algorithms - The Construction, Proof & Analysis of Programs** [4] K. Melhorn: **Data Strucures and Algorithms, Vol. I & II**	

1 **Matter in contrast (black background & white letters) is shifted to some other units, and material brought as a result of shift is also in contrast.**

[2] **Matter in square brackets, bold, italic and crossed is deleted.**
[3] **Proposed added materials are shaded in grey.**

MCA III/M.Sc. I Sem

3.3:Theory Of Computation

Contact hours:60

Section	Existing Syllabus (2014-15)	Proposed Syllabus (2015-16)	Remarks/ Justification
Title	**Compiler Design** **Objectives:** • To have an in-depth knowledge of theory of computation • To understand context-free grammars • To understand Turing machines & turning computability • To understand about undecidable problems	**Compiler Design** **Objectives:** • To have an in-depth knowledge of theory of computation • To understand context-free grammars • To understand Turing machines & turning computability • To understand about undecidable problems	
Sec-A	Mathematical preliminaries, alphabets, strings, Languages, states, transitions, finite automata and regular expressions, applications e.g. Lexical analyzers and text editors, the pumping Lemma & closure property of regular sets, decision algorithms for regular sets.	Mathematical preliminaries, alphabets, strings, Languages, states, transitions, **automata with & without output(Mealy & Moore machine** and regular expressions, applications e.g. Lexical analyzers and text editors, the pumping Lemma & closure property of regular sets, decision algorithms for regular sets.	
Sec-B	Context free grammars, Chomsky and Greibach normal form theorems, ambiguity, Pushdown automata and the equivalence of context free languages to sets accepted by non-deterministic PDA, the Pumping Lemma for CFL's, closure properties of CFL's and decision algorithms for CFL's.	Context free grammars, Chomsky and Greibach normal form theorems, ambiguity, Pushdown automata and the equivalence of context free languages to sets accepted by non-deterministic PDA, the Pumping Lemma for CFL's, closure properties of CFL's and decision algorithms for CFL's.	
Sec-C	Turing Machines: Introduction, Turing hypothesis, Turing computability, nondeterministic, multitape and other versions of Turing machine, Church's hypothesis, primitive recursive function, Godelization, recursively enumerable Languages and	Turing Machines: Introduction, Turing hypothesis, Turing computability, nondeterministic, multitape and other versions of Turing machine, Church's hypothesis, primitive recursive function, Godelization, recursively enumerable Languages and	

	Turing Computability. Undecidability: Universal Turing machines and unsolvability of the halting problem, an undecidable problem, Post's Correspondence problem.	Turing Computability. Undecidability: Universal Turing machines and unsolvability of the halting problem, an undecidable problem, Post's Correspondence problem.	
	Text Book: 1. Hopcroft J.E. and Ullman J.D., Introduction to Automata Theory, Languages and Computation, Narosa Publishing House. 2002, Ist ed. **Reference Books:** 1. Wood Derick, Theory of Computation, Harper & Row Publishers, New York. 1987, Ist ed. 2. Lewis H.R. & Papadimitriou C.H, Elements of the Theory of Computation, Prentice Hall International Inc. 2001, Ist ed.	**Text Books:** **Text Book:** 1. Hopcroft J.E. and Ullman J.D., Introduction to Automata Theory, Languages and Computation, Narosa Publishing House. 2002, Ist ed. 2. K. L. P. Mishra an N.Chandrasekaran Theory of Computer Science, Automata,Languages amd Computation , PHI publication **Reference Books:** **Reference Books:** 1. Wood Derick, Theory of Computation, Harper & Row Publishers, New York. 1987, Ist ed. 2. Lewis H.R. & Papadimitriou C.H, Elements of the Theory of Computation, Prentice Hall International Inc. 2001, Ist ed.	One more Text book is added (provides more exercises)

MCA III/M.Sc I Sem

Software Engineering

Contact hours: 4/Week

Section	Existing Syllabus (2015-16)	Proposed Syllabus (2016-17)	Remarks/ Justification
Title	**Software Engineering**	**Software Engineering**	
Objective	• To familiarize with concepts of software engineering • To learn software designing • To understand Software quality assurance, software maintenance & re-engineering concepts	• To familiarize with concepts of software engineering • To learn software designing • To understand Software quality assurance, software maintenance & re-engineering concepts	
Sec A	Software engineering concepts, historical perspective, software evaluation, program design paradigms. Software project planning : identifying software scope, resources, analysis concept, analysis modeling (behavioral model, data model, functional model), analysis tools & techniques, risk management, project scheduling, tracking. Cost estimation : project metrics, cost factors, cost estimation techniques (decomposition, empirical, automated estimation, delphi)	Software engineering concepts, historical perspective, software evaluation, program design paradigms. Software project planning : identifying software scope, resources, **Feasibility study, cost/benefit analysis, information gathering**, analysis concept, analysis modeling (behavioral model, data model, functional model), **Need & Role of System Analyst.** analysis tools & techniques, risk management, project scheduling, tracking. Cost estimation : project metrics, cost factors, cost estimation techniques (decomposition, empirical, automated estimation, delphi)	Some portion has been added so that the course can suffice the need for System Analysis of Design as well
Sec B	System design : Design concepts & principles (modularization, abstraction, refinement, cohesion, coupling) design methods (structured design, object oriented design, real time system design), Implementation : modern programming language features & characteristics, language classes, coding style, efficiency.	System design : Design concepts & principles (modularization, abstraction, refinement, cohesion, coupling) design methods (structured design, **database design**, **user interface design**, object oriented design, real time system design), Implementation : modern programming language features & characteristics, language classes, coding style, efficiency.	Some portion has been added so that the course can suffice the need for System Analysis of Design as well

Sec 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, validation system, testing), Maintenance: Maintenance characteristics, Maintainability, software reuse, re-engineering, reverse engineering, CASE.	Software Quality Assurance : **Risk management,** Quality factors and criteria, SQA metrics , SQA techniques. Verification and Validation : software testing methods (WBT, BBT), software testing strategy (Unit testing, integration testing, validation system, testing), **System Implementation/conversion: Direct, parallel, Pilot, phased.** Maintenance: Maintenance characteristics, Maintainability, software reuse, re-engineering, reverse engineering, CASE.	Some portion has been added so that the course can suffice the need for System Analysis of Design as well
	Text Books: 1. 1. Pressman R.S., Software Engineering - A practitioner's approach , Tata McGraw Hill , 4th edition, 1997. 2. Jalote P., An Integrated approach to Software Engineering, Narosa Publications, 2003. 3. Awad Elias, System Analysis and Design second edition Galgotia Publications. 4. Rajaraman V. , Analysis and Design of Information Systems, second edition PHI **Reference Books:** 1. 1. Fairley R., Software Engineering Concepts, Tata McGraw Hill, 1997. 2. Rajib mall, Fundamental of software engineering, Prentice Hall,2004 3. Sommerville, Software Engineering, Pearson Education, 2008.	**Text Books:** 5. 1. Pressman R.S., Software Engineering - A practitioner's approach , Tata McGraw Hill , 4th edition, 1997. 6. Jalote P., An Integrated approach to Software Engineering, Narosa Publications, 2003. 7. Awad Elias, System Analysis and Design second edition Galgotia Publications. 8. Rajaraman V. , Analysis and Design of Information Systems, second edition PHI **Reference Books:** 4. 1. Fairley R., Software Engineering Concepts, Tata McGraw Hill, 1997. 5. Rajib mall, Fundamental of software engineering, Prentice Hall,2004 6. Sommerville, Software Engineering, Pearson Education, 2008.	

MCA III/M.Sc. I Sem

Operating System

Contact hours: 4/Week

Section	Existing Syllabus (2015-16)	Proposed Syllabus (2016-17)	Remarks/ Justification
Title	**Operating System**	**Operating System**	
Objective	• Introduction to Operating system classification. • Concepts of information management. • Concepts related to process management and inter process communication. • To familiarize the students with UNIX Operating System.	• Introduction to Operating system classification. • Concepts of information management. • Concepts related to process management and inter process communication. • To familiarize the students with UNIX Operating System.	
Sec A	~~History of operating systems~~, O S Functions, OS classification: single user, multiuser, ~~simple monitor~~, batch processing, time sharing, real time OS, information management. ~~Management file supports, access methods, allocation methods, contiguous, linked and indexed allocation, directory system.~~ ~~Memory management: partition, paging and segmentation, virtual memory and demand paging.~~ ~~Device management: Disk and drum scheduling algorithm, protection of resources, I/O processor management: I/O traffic controller, I/O scheduler, I/O device handlers.~~	Operating system 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,Operating Systems for Embedded Devices, Introduction to popular operating systems like UNIX, DOS, Windows, etc.*** ***Parallel processing and distributed processing: concept, differences, OS.*** ***Process management: Process status, schedulers, scheduling algorithms*** ***Inter process communication: Shared memory and message passing, Process Synchronization, Critical Section problem and its hardware, software and semaphore solutions, classical problems in concurrent programming.***	Few more concepts added and Some Concepts Sifted from Sec B
Sec B	~~Process management: Process status, levels of schedulers, scheduling algorithms.~~ ~~Inter process communication: Process Synchronization, Critical Section problem and its software, hardware and semaphore solutions, Deadlock prevention, avoidance, detection and recovery. Protection and Security,Parallel processing. Difference between distributed and parallel processing, OS for parallel processors.~~	Memory management: partition, paging and segmentation demand paging, virtual memory, page replacement algorithms, thrashing. Secondary storage: Disks, disk space management, Scheduling algorithms. Management file supports, access methods, allocation methods, contiguous, linked and indexed allocation, directory Systems I/O processor management: I/O traffic controller, I/O scheduler, I/O device handlers.	Shifted from Unit-A

Sec C	~~Case study: Unix: Unix history, Design principles, programmer interface, user interface, file system, process management, memory management, I/O system, inter process commands, vi editor, Unix shell, communication management in Netware, Netware features, windowing technology, relationship between OS and windows, GUI components.~~	Deadlock: Prevention, Avoidance, Detection and recovery. Protection and Security - Accessibility and Capability Lists UNIX: File System, Inode, Types of shells, Commands (basic, file mgmt, process mgmt, pipelines), vi editor, shell programming.	Shifted from Unit-A UNIX case study is updated(only imported portions are included)
	Text Books: 1. Silberschatz, Galvin, Gagne,Operating System Concepts, Addision Wiley Publications, 6th edition, 2003. 2. A Godbole, Operating systems with case studies in Unix, Netware, Windows NT", Tata McGraw Hill Publications, 1995. 3. Y Kanetkar, Unix Shell programming, BPB Publications, 1997. **Reference Books:** 1. A Tananbeum, Modern Operating Systems, Prentice Hall Publications, 3rd edition 2009. 2. H. M. Deitel, Operating Systems, Pearson education, 2nd edition, 2003.	**Text Books:** 1. Silberschatz, Galvin, Gagne,Operating System Concepts, Addision Wiley Publications, 6th edition, 2003. 2. A Godbole, Operating systems with case studies in Unix, Netware, Windows NT", Tata McGraw Hill Publications, 1995. 3. Y Kanetkar, Unix Shell programming, BPB Publications, 1997. **Reference Books:** 1. A Tananbeum, Modern Operating Systems, Prentice Hall Publications, 3rd edition 2009. 2. H. M. Deitel, Operating Systems, Pearson education, 2nd edition, 2003.	

MCA-IV/M.Sc. II Sem
Communication Skills

Section	Existing Syllabus(2015-16)	Revised Syllabus(2016-17)	Remarks
Title	**Communication Skills**	**Communication Skills**	
Objectives	• To overcome hesitation and fear of public speaking • To improve communication skills and enhance personal effectiveness • To improve writing skills and instill confidence while writing for job applications • Developing skills for facing group discussions and job interviews confidently.	• To overcome hesitation and fear of public speaking • To improve communication skills and enhance personal effectiveness • To improve writing skills and instill confidence while writing for job applications • Developing skills for facing group discussions and job interviews confidently.	No changes
Section-A	Types of Communication- oral communication, written communication- formal, informal, Business letters – types of letter, writing letters, business correspondence, applying for job, Resume writing, filling out employment application. Language skills: constructing correct sentences by using the right tenses, prepositions, concord. Vocabulary building .	Types of Communication- oral communication, written communication- formal, informal, Business letters – types of letter, writing letters, business correspondence, applying for job, Resume writing, filling out employment application. Language skills: constructing correct sentences by using the right tenses, prepositions, concord. Vocabulary building .	No changes
Section-B	Report writing- Defining and determining reports purpose, Report Planning, collecting information, Developing an outline, section of report, types of report, writing short reports, writing long project reports. Writing an abstract for a research paper, dissertation, project report, guidelines for writing a good abstract.Writing a project synopsis-research project synopsis and summer training project synopsis. Guidelines for writing a good research paper	Report writing- Defining and determining reports purpose, Report Planning, collecting information, Developing an outline, section of report, types of report, writing short reports, writing long project reports. Writing an abstract for a research paper, dissertation, project report, guidelines for writing a good abstract.Writing a project synopsis-research project synopsis and summer training project synopsis. Guidelines for writing a good research paper	No changes

Section-C	**<<No Section-C>>**	Introduction to soft skills and hard skills, self development-etiquette and manners, positive attitude and self confidence, motivation skills, communication skills. Body language: Facial Expression, Posture, Gesture, eye contact, Appearance (Dress Code). Interpersonal Skills: Negotiations, listening skills, social skills, assertive skills, cross-cultural communications. Goal setting, priority management, time management & career planning. Resume building, Group discussions and Interview skills: Effective interview techniques, mock interviews, stress interviews.	Added Section-C containing topics on personality development
	Text Books: • 1. Raman Meenakshi & Sharma Sangeeta, Technical Communication –Principles and Practice, Oxford University Press, New Delhi,2004. 2. Kaul, Asha, Business Communication 2nd edition, PHI learning Pvt Ltd, New Delhi, 2009 **Reference Books:** 1. Tyagi Kavita & Mishra Padma, Advanced Technical Communication, PHI learning Pvt Ltd. New Delhi, 2011. 2. Sharma Sangeeta & Mishra Binod, Communication skills for Engineering and Scientists, PHI learning Pvt Ltd, New Delhi, 2009. 3. Flatley, Lesiker.,Basic Basic Business Communication, 10th edn. New Delhi : Tata	**Text Books:** 1. Raman Meenakshi & Sharma Sangeeta, Technical Communication –Principles and Practice, Oxford University Press, New Delhi,2004. 2. Kaul, Asha, Business Communication 2nd edition, PHI learning Pvt Ltd, New Delhi, 2009 3. SOFT SKILLS, 2015, Career Development Centre, Green Pearl Publications. **Reference Books:** 1. Tyagi Kavita & Mishra Padma, Advanced Technical Communication, PHI learning Pvt Ltd. New Delhi, 2011. 2. Sharma Sangeeta & Mishra Binod, Communication skills for Engineering and Scientists, PHI learning Pvt Ltd, New Delhi, 2009.	Added an extra text book and a few reference books for personality development topics

	McGraw Hill, 2005. 4. Flatley, Lesiker.,Basic Business Communication:Making Connections in a Digital World, 11th edn. New Delhi : Tata McGraw Hill, 2008. 5. Chaturvedi, P.D. and Mukesh Chaturvedi, Business Communication, 2nd edition New Delhi:Pearson, 2011.	3. Flatley, Lesiker.,Basic Basic Business Communication, 10th edn. New Delhi : Tata McGraw Hill, 2005. 4. Flatley, Lesiker.,Basic Business Communication:Making Connections in a Digital World, 11th edn. New Delhi : Tata McGraw Hill, 2008. 5. Chaturvedi, P.D. and Mukesh Chaturvedi, Business Communication, 2nd edition New Delhi:Pearson, 2011. 6. Covey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers, 1998. 7. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998. 8. Thomas A Harris, I am ok, You are ok , New York-Harper and Row, 1972	
	Evaluation : The total marks allotted to the course are – 25, which will be awarded based on A. Continuous Assessment - 5 Marks B. Annual Assessment - 20 Marks The continuous assessment could be done in the form of Viva whereas for the annual exam the student has to answer three questions, one essay type question of 10 marks and other two short questions of 5 marks each. Each question should have internal choice. The duration of the exam be – 2 Hours.	**Evaluation :** The total marks allotted to the course are – 25, which will be awarded based on A. Continuous Assessment - 5 Marks B. Annual Assessment - 20 Marks The continuous assessment could be done in the form of Viva whereas for the annual exam the student has to answer three questions, one essay type question of 10 marks and other two short questions of 5 marks each. Each question should have internal choice. The duration of the exam will be – 2 Hours.	No changes

MCA V / MSc. (CS) III Semester

Distributed Computing

Contact hours: 60

Section	Existing Syllabus (2015-16)	Proposed Syllabus (2017-18)	Remarks/ Justification
Title	**Distributed Computing**	**Distributed Computing**	
Objectives	1. To understand distributed computing concepts and issues. 2. To have understanding of distributed algorithms. 3. To expose the synchronous and	1. To understand distributed computing concepts and issues. 2. To have understanding of distributed algorithms. 3. To expose the synchronous and asynchronous model of distributed algorithm	
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.~~	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.	
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.	Distributed Algorithms : Introduction to distributed algorithms, synchronous and partial synchronous models, Algorithms in general synchronous leader election (LCR Algorithm, HS Algorithm, A Simple Flooding Algorithm) , Breadth first search, shortest path, Minimum Spanning Tree, Maximal Independent Set, Distributed consensus with link and process failures. Asynchronous system model, I/O automata, operation of automata, complexity measures, randomizations.	Specifying the topics to be read.
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.~~	Asynchronous shared memory model, mutual exclusion (Dijkstra Mutual Exclusion Algorithm, Lockout-free Mutual Exclusion Algorithm, An algorithm using Single-Writer Shared Register, Bakery Algorithm), resource allocation (Dining Philosophers Problem, Right-Left Dining Philosophers Algorithm, Randomized Dining Philosopher Algorithm), Consensus, Asynchronous network model (Send/Receive Systems, Broadcast Systems, Multicast Systems), basic	Specifying the topics to be read

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		asynchronous network algorithms, shared memory Vs Networks.	
	Text Books: **Text Reference/Books : Suggested** 1. PK Sinha, Distributed Operating System, PHI, 1997. 2. AS Tanenbaum, Modern Operating Systems, PHI. 3. Nancy A Lynch, Distributed Algorithms, Morgan Kaufmann Pub. Inc., 1996. ~~4. DF Rumelhart, JI Mc Clelland & PDP group, Parallel Distributed Processing vol I&II, MIT Press, 1995.~~ ~~5. Simon Haykin, Neural Networks, IEEE Press.~~	**Text Books:** **Text Reference/Books : Suggested** 1. PK Sinha, Distributed Operating System, PHI, 1997. 2. AS Tanenbaum, Modern Operating Systems, PHI. 3. Nancy A Lynch, Distributed Algorithms, Morgan Kaufmann Pub. Inc., 1996.	

MCA V/M.Sc. (CS) III Semester

Artificial Intelligence

Contact hours: 55

Section	Existing Syllabus (2015-16)	Proposed Syllabus (2017-18)	Remarks/ Justification
Title	**Artificial Intelligence**	**Artificial Intelligence**	
Objectives	• To understand the introduction to concept of Artificial Intelligence. • To learn knowledge representation in A.I. • Concepts of Natural language understanding. • To understand concept and case studies of expert system. • To learn about pattern recognition, Analysis of visual & speech pattern and introduction to Machine learning.	• To understand the introduction to concept of Artificial Intelligence. • To learn knowledge representation in A.I. • To understand concept of Cognitive Computing. • To understand the process of design and implement a Cognitive System.	Objectives are revised
Section-A	Introduction to Artificial Intelligence, General problem solving, state space and graph model techniques, Heuristic designs, Aim-oriented heuristic algorithms versus solution guaranted algorithms, Game playing strategies. Knowledge representation : Knowledge representation tools, First order predicate calculus. The language PROLOG - sementic nets, partitioned nets, Minsky's frames, case grammer theory, production rules, knowledge base, the inference system, forward and backward deduction.	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 :** Knowledge representation tools, First order predicate calculus. Understanding Logic Programming Using PROLOG. Semantic Nets, Frames, production rules, knowledge base, the inference system, forward and backward deduction.	No Change
Section-B	Understanding Natural Language, Parsing techniques, context free and transformational grammer, transition net, augumented transition nets, Fillmore's grammer, Shanks conceptual dependency. Grammer free analysers, Sentence generation, Translation. ~~Expert systems : Structure, development tools, uncertainty considerations, domain exploration, meta knowledge, expertize transfer, existing systems (DENDRAL, MYCIN), self explaining systems.~~	**Cognitive Computing:** Introduction, Elements of Cognitive Systems. Understanding Complex Relationships Between Systems. Understanding Cognition. Transformation of Artificial Intelligence into Cognitive Computing Systems. Uses of Cognitive Computing Systems. System of Judgment and Choice. Designing a Cognitive System. Graining Insight from Data. Bringing Data into Cognitive System. Defining Objective. Defining Domain. Understanding the Intended Users and Defining their Attributes. Defining Questions and Exploring Insights. Creating and Refining the Corpora. Training and Testing.	Cognitive Computing has been introduced. As over the Artificially Intelligent Systems have seen tremendous advancement

		Understanding Natural Language, Parsing techniques, context free and transformational grammer, transition net, augumented transition nets, Fillmore's grammer, Shanks conceptual dependency. Grammer free analysers, Sentence generation, Translation.	and have transformed into cognitive systems.
Section-C	~~Pattern recognition : Structured description, symbolic description; machine perception: Vision & Speech; techniques used in solving preceptual problems, analysing visual clues (edge detection); speech recognition : Problems in speech recognition, analyzing speech, Introduction to machine learning.~~	Enabling Reasoning in Cognitive Systems Through Probabilistic Learning: Bayesian Networks, Approximate Inference, Constructing Bayesian Networks. Markov Chains, Hidden Markov Model: Forward Algorithm, Viterbi Algorithm, Baum-Welch Algorithm. Application of Cognitive Computing: Enhancing the Shopping Experience. Leveraging the Connected World of Internet of Things. Voice of the Computer. Fraud Detection. Case Study of Cognitive Computing Systems.	Probabilistic Learning and applications of cognitive systems have been introduced
	Text Books : 1. Rich Elaine & Knight Kevin, Artificial Intelligence, Mc-Graw Hill, 1991. 2. Patterson Dan W, **Introduction to Artificial Intelligence and Expert Systems**, PHI., India, 1990. **Reference Books:** 1. Avron Barr & Edward A. Feigenbauen, The Handbook of Artificial Intelligence., Addison-Wesley Pub, Vol I, Vol II, Vol III, 1982 2. James Allen, Natural Language Understanding, 2nd Edition, Pearson Education India, 1995. 3. Nilsson N.J., Principles of Artificial Intelligence, Narosa Publishing, 1991. 4. Nils J. Nilsson, "AI: A New Synthesis", by, Morgan Kaufmann Inc., 1998 5. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, 2002 6. George F. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Addison-Wesley, 2002 7. Jackson Peter, Introduction to Expert Systems, Addison Wesley, 1998.	**Text and Reference Books:** 1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Ed, Prentice Hall, 2013. 2. David Vermon, "Artificial Cognitive Systems A Primer", MIT Press, 2014. 3. Rich Elaine & Knight Kevin, Artificial Intelligence, 3 Ed, Mc-Graw Hill, 2011. 4. Patterson Dan W, Introduction to Artificial Intelligence and Expert Systems, Pearson Education, India, 1990. 5. Avron Barr & Edward A. Feigenbauen, The Handbook of Artificial Intelligence., Addison-Wesley Pub, Vol I, Vol II, Vol III, 1982 6. James Allen, Natural Language Understanding, 2nd Edition, Pearson Education India, 1995. 7. Nilsson N.J., Principles of Artificial Intelligence, Narosa Publishing, 1991. 8. Nils J. Nilsson, "AI: A New Synthesis", by, Morgan Kaufmann Inc., 1998. 9. George F. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Addison-Wesley, 2002. 10. Charniak E. & McDermott D., Introduction to Artificial	

	8. Charniak E. & McDermott D., Introduction to Artificial Intelligence, Addison Wesley, 1985. 9. Tau & Genzales, Pattern Recognition Principles, Addison-Wesley, 1974.	Intelligence, Addison Wesley, 1985.	

MCA V/M.Sc III semester
Big Data Analytics

Objectives

- To Understand Big Data use cases and solutions.
- To Build and maintain, reliable, scalable, distributed systems with Apache Hadoop.
- To Apply Hadoop Ecosystem Components for Analytics.

Section A

Introduction to Big Data, Evolution, Structuring Big Data, Types of Big Data, 4 Vs, 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, Point Solutions, Data Visualization for Big Data.

Section B

Gathering Data on a Distributed Environment. Architecture and Features of Hadoop Framework: HDFS, MapReduce, 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. Controling 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.

Text and Reference Books

- White, Tom. Hadoop: The definitive guide. " O'Reilly Media, Inc.", 2012.
- Miner, Donald, and Adam Shook. MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems. O'Reilly Media, Inc., 2012.
- Loshin, David. Big data analytics: from strategic planning to enterprise integration with tools, techniques, NoSQL, and graph. Elsevier, 2013.

MCA V/ M.Sc. III Semester
Elective : Digital Image Processing

Contact hours: 55

Section	Existing Syllabus (2015-16)	Proposed Syllabus (2016-17)	Remarks/ Justification
Title	**Elective : ~~Pattern Recognition and Image Processing~~**	**Elective : Digital Image Processing**	Major portion deals with IP.
Objective	• Introduction to concept of Image processing. • Mathematical preliminary of Image processing and various Image representation. • Concepts and Methods of image enhancement. • Concepts and Methods of image analysis.	• Introduction to concept of Image processing. • Mathematical preliminary of Image processing and various Image representation. • Concepts and Methods of image enhancement. • Concepts and Methods of image analysis.	
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.	Image processing: introduction, linear systems, the Fourier transforms, matrix theory results. Image Perception: Light, Luminance, Brightness, Contrast, MTF of Visual System, Visibility Function, Monochrome Vision Models and Color Vision Models, Temporal properties of vision. Image Sampling: 2-D sampling theory, Nyquist theorem. Image Quantization: Optimum Mean Square (Lloyd-Max) Quantizer, Compandor design.	Moved some portions from Section A of exiting syllabus to Section B of the proposed syllabus. Some items are arranged, elaborated and grouped.
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.	Image transforms: two dimensional orthogonal and unitary transforms, properties, one dimensional discrete Fourier transform (DFT), two dimensional DFT, Cosine transform, Sine transform. Image enhancement: point operation, histogram modeling, spatial operations, transform operation, multispectral image enhancement, false color and pseudocolor, color image enhancement. Image filtering and restoration: image observation models, Inverse and Wiener filtering, finite impulse response (FIR) wiener filtering, other Fourier domain filters.	Portions of Section A have been moved to Section B. Some relevant portions are added.
SECTION- C	Image Analysis: Feature extraction, Edge detection, Scene segmentation and labeling. Pattern recognition: Introduction, Recognition process, Statistical decision making (Bayes'	Image Analysis: Feature extraction, Edge detection, Scene segmentation and labeling. Pattern recognition: Introduction, Recognition process, Statistical	

	theorem), Nonparametric decision making (Nearest neighborhood classification ~~tech~~), clustering.	decision making (Bayes' theorem), Nonparametric decision making (Nearest neighborhood classification techniques), Clustering.	
	Text Books: 1. Jain A. K., Fundamentals of Digital Image Processing, PHI Publications,1989. 2. ~~Gozalez Rafel, Woods Richard, Digital Image Processing, 2nd edition, Pearson Education, 2002~~ **Reference Books:** 1. Rosenfield, A and Kak A. C, Picture Processing, Academic Press N.Y. 1982 2. Pratt, W. K., Digital Image Processing, 2nd edition, John Willey and sons, New York,1991 . 3. Duda R., Hart Peter, Stork D., Pattern Classification, Willey Interscience Publication, 1973. 4. Manahem Friedman, Abraham Kandel, Introduction to Pattern Recognition, World Scientific, 1999.	**Text Books:** 1. Jain A. K., Fundamentals of Digital Image Processing, PHI Publications, 1989. 2. Gozalez Rafael C., Woods Richard E., Digital Image Processing, 3rd edition, Pearson Education, 2008. **Reference Books:** 1. Jayaraman S., Esakkirajan S., Veerakumar T., Digital Image Processing, Tata McGraw Hill Education Private Limited, New Delhi, 2009. 2. Rosenfield, A and Kak A. C, Picture Processing, Academic Press N.Y. 1982 3. Pratt, W. K., Digital Image Processing, 2nd edition, John Willey and sons, New York,1991 . 4. Duda R., Hart Peter, Stork D., Pattern Classification, Willey Interscience Publication, 1973. 5. Manahem Friedman, Abraham Kandel, Introduction to Pattern Recognition, World Scientific, 1999.	

[1] **Matter in contrast (black background & white letters) is shifted to some other units, and material brought as a result of shift is also in contrast.**
[2] **Matter in square brackets, bold, italic and crossed is deleted.**
[3] **Proposed added material is shaded in grey.**

Proposed

MCA V /M.Sc. III Sem. (Elective Paper)

Cyber Security

Section-A

Introduction to Cybersecurity, Cybersecurity: objectives, roles; Differences between Information Security & Cybersecurity. Cybersecurity Principles: The CIA triad (Confidentiality, integrity, & availability), Authentication & non-repudiation

Section-B

Information Security (IS) within Lifecycle Management, Lifecycle management landscape, Security architecture processes, Security architecture tools, Intermediate lifecycle management concepts, Risks & Vulnerabilities, Basics of risk management

Section-C

Operational threat environments, Classes of attacks, Incident Response, Incident categories Incident response, Incident recovery, Future Implications & Evolving Technologies, New & emerging IT & IS technologies Mobile security issues, risks, & vulnerabilities, Cloud concepts around data & collaboration

Text Books:

1. Introduction to Computer Networks and Cybersecurity , Chwan Hua, CRC Press, Taylor and Francis.
2. The Art of Software Security Assessment: Identifying and Preventing Software Vulnerabilities, 1st Edition, Addison-Wesley Professional.

Reference Book:

1. Cyber Security Essentials, James Graham, CRC Press, Taylor and Francis.

Verified

Offg. Secretary
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P.O. Banasthali Vidyapith
Distt. Tonk (Raj.)-304022

Department of Computer Science

Banasthali Vidyapith, Banasthali

Minutes of the Board of Studies held on 26.12.2018 at 04.00 p.m. in the Conference Hall, Vidya Mandir, Banasthali Vidyapith

Present

1.	Mrs. Abha Purohit	:	Internal Member
2.	Dr. Abhay Kumar Rai	:	Internal Member
3.	Dr. Ajay Kumar Yadav	:	Internal Member
4.	Dr. Ajit Kumar Jain	:	Internal Member
5.	Ms. Amrita	:	Internal Member
6.	Mrs. Anjali Verma	:	Internal Member
7.	Dr. Anup Kumar Bhola	:	Internal Member
8.	Mr. Ashok Kumar	:	Internal Member
9.	Mrs. Bharti Nathani	:	Internal Member
10.	Dr. Deepak Kumar	:	Internal Member
11.	Ms. Deepti Goswami	:	Internal Member
12.	Mrs. Deepti Saxena	:	Internal Member
13.	Mrs. Dipanwita Thakur	:	Internal Member
14.	Mrs. Divya	:	Internal Member
15.	Mrs. Karuna Sharma	:	Internal Member
16.	Ms. Kirti Pandey	:	Internal Member
17.	Prof. Kusum Gupta	:	Internal Member
18.	Mr. Lat Sahab	:	Internal Member
19.	Dr. Mainaz Faridi	:	Internal Member
20.	Dr. Manisha Agarwal	:	Internal Member
21.	Dr. Manisha Jailia	:	Internal Member
22.	Dr. Manjeet Kumar	:	Internal Member
23.	Mrs. Monika	:	Internal Member
24.	Ms. Monika Saxena	:	Internal Member
25.	Ms. Monika Narang	:	Internal Member
26.	Dr. Neelam Sharma	:	Internal Member
27.	Dr. Nisheeth Joshi	:	Internal Member
28.	Ms. Pooja Asopa	:	Internal Member
29.	Mrs. Pooja Gupta	:	Internal Member
30.	Dr. Pradeep Kumar Sharma	:	Internal Member
31.	Dr. Rajiv Singh	:	Internal Member

32. Mrs. Richa Jain	:	Internal Member
33. Mr. Roopesh Kumar	:	Internal Member
34. Dr. Sanjay Kumar Sharma	:	Internal Member
35. Dr. Saurabh Mukherjee	:	Internal Member
36. Ms. Sneha Asopa	:	Internal Member
37. Dr. Sudha Morwal	:	Internal Member
38. Mr. Sushil Buriya	:	Internal Member
39. Ms. Uma Sharma	:	Internal Member
40. Mr. Vivek Purohit	:	Internal Member
41. Dr. Yogesh Kumar Gupta	:	Internal Member
42. Prof. Chandra Kumar Jha	:	Convener
43. Prof. P. K. Mishra	:	External Member

Note: Prof. Shashikala Tapaswi, Gwalior, M.P. (External Member), Dr. Aditi Paul, Dr. Archana Mangal, Ms. Deepika Sainani, Dr. Iti Mathur Joshi, Dr. Khandakar F. Rahman, Dr. Kuldeep Kumar Yogi, Ms. Meenakshi Pareek, Ms. Sakshi Indolia, Dr. Vaibhav Vyas (Internal Members) could not attend the meeting.

The meeting started with a welcome of the members, by the convener of Board of Studies for Computer Science, Prof. C. K. Jha, Head, Department of Compute Science, Banasthali Vidyapith, Rajasthan.

1. The board confirmed the minutes of its last meeting held on 30th April, 2016.

2. The board reviewed the existing panel of examiners and suggested to update the address and phone numbers of the existing examiners for each examination up to and inclusive of all Master's Degree examination keeping in view the by-law 15.03.2002 of the Vidyapith. Updated panel is sent to the examination and secrecy section.

3. The board reviewed the Study/ Curricula, scheme of examination and proposed revisions in various courses of study as follows:

3 I BCA:

i.	First Semester (2019-20)	No Change
ii.	Second Semester (2019-20)	No Change
iii.	Third Semester (2020-21)	No Change
iv.	Fourth Semester (2020-21)	Minor Change [a]
v.	Fifth Semester (2021-22)	Change in Nomenclature [b, c, d]
vi.	Sixth Semester (2021-22)	Change in Nomenclature [e]

In the scheme of BCA following changes were suggested:

(a) In BCA IV, weekly practical hours of **CS 201L "Application Software and Visual Computing"** were proposed to be raised to 6 hrs./ week from 4 hrs./ week raising the credits of the course to 9 credits from 8 credits.

(b) In BCA V Semester, nomenclature of the course **CS 305** "**Java Programming Applications"** was proposed to be changed to **"Programming in Java"** as the contents of the syllabus do not reflect Java programming applications.

(c) In BCA V Semester, nomenclature of the course **CS 305L "Java Programming Applications Lab"** was proposed to be changed to **"Programming in Java Lab"** as the contents of the Lab syllabus do not reflect Java programming applications.

(d) In BCA V Semester, core course **CS 303 "Database Management Systems"** and **CS 303L "Database Management Systems Lab"** were proposed to be replaced by **Discipline Elective - I** and **Discipline Elective – I Lab** courses (the list of Discipline Elective – I and Discipline Elective – I Lab courses are provided as part of the scheme).

(e) In BCA VI Semester, core course **CS 301 "Communication and Networking"** was proposed to be replaced by **Discipline Elective – II** course (the list of Discipline Elective – II courses is provided as part of the scheme).

The Board reviewed the Programme Educational Objectives, Programme Outcomes, and Learning Outcomes for Courses. The board also recommended modifying the format of *Suggested Books*, and inclusion of *Suggested E-Resources* in all the courses of BCA.

Programme Educational Objectives, Program Outcomes and Programme Scheme of BCA is attached and marked as **Annexure-I.**

The Course Details, including Course Code, Course Name, Learning Outcomes, Existing Syllabus, Revised Syllabus (if required) with Suggested Books and E-Resources, and Remarks for BCA courses is attached and marked as **Annexure-II.**

3 II B.Sc.:

i.	First Semester (2019-20)	No Change
ii.	Second Semester (2019-20)	No Change
iii.	Third Semester (2020-21)	No Change
iv.	Fourth Semester (2020-21)	No Change
v.	Fifth Semester (2021-22)	Change [a]
vi.	Sixth Semester (2021-22)	Changes [b, c]

In the scheme of B.Sc. following changes were suggested for courses related to Computer Science.

(a) In B.Sc. V Semester, core course **CS 316 "Business Data Processing and Database Management System"** and **CS 316L "Business Data Processing and Database Management System Lab"** were proposed to be replaced by **Discipline Elective - I** and **Discipline Elective – I Lab** courses (the list of Discipline Elective – I and Discipline Elective – I Lab courses are provided as part of the scheme).

(b) In B.Sc. VI Semester, core course **CS 301 "Communication and Networking"** was proposed to be replaced by **Discipline Elective – II** course (the list of Discipline Elective – II courses is provided as part of the scheme).

(c) In B.Sc. VI Semester, nomenclature of the course CS 301L "**Communication and Networking Lab**" is suggested to be changed to **"Project"** and accordingly new course code is suggested to be assigned.

The Board reviewed the inclusion of Learning Outcomes for all the Courses. The board also recommended modifying the format of *Suggested Books*, and inclusion of *Suggested E-Resources* in all the courses of B.Sc.

Programme Scheme of B.Sc. is attached and marked as **Annexure-III.**

The Course Details, including Course Code, Course Name, Learning Outcomes, Existing Syllabus, Revised Syllabus (if required) with Suggested Books and E-Resources, and Remarks for B.Sc. courses is attached and marked as **Annexure-IV.**

3 III BA:

i.	First Semester (2019-20)	No Change
ii.	Second Semester (2019-20)	No Change
iii.	Third Semester (2020-21)	No Change
iv.	Fourth Semester (2020-21)	No Change
v.	Fifth Semester (2021-22)	Change [a]
vi.	Sixth Semester (2021-22)	Change [b]

In the scheme of BA following changes were suggested for courses related to Computer Science.

(a) In BA V Semester, core course **CS 303 "Database Management System"** and **CS 303L "Database Management System Lab"** were proposed to be replaced by **Discipline Elective - I** and **Discipline Elective – I Lab** courses (the list of Discipline Elective and Discipline Elective Lab courses are provided as part of the scheme).

(b) In BA VI Semester, core course **CS 306 "Multimedia and Web Designing"** and **CS 306L "Multimedia and Web Designing Lab"** were proposed to be replaced by **Discipline Elective - II** and **Discipline Elective – II Lab** courses (the list of Discipline Elective and Discipline Elective Lab courses are provided as part of the scheme).

The Board reviewed the inclusion of Learning Outcomes for all the Courses. The board also recommended modifying the format of *Suggested Books*, and inclusion of *Suggested E-Resources* in all the courses of BA.

Programme Scheme of BA is attached and marked as **Annexure-V.**

The Course Details, including Course Code, Course Name, Learning Outcomes, Existing Syllabus, Revised Syllabus (if required) with Suggested Books and E-Resources, and Remarks for BA courses is attached and marked as **Annexure-VI.**

3 IV MCA/ M.Sc. (Computer Science):

(A) MCA

i.	First Semester	Minor Change [a]
ii.	Second Semester	No Change
iii.	Third Semester	No Change
iv.	Fourth Semester	Minor Changes [b, c]
v.	Fifth Semester	Changes [d, e, f, g, h, i]
vi.	Sixth Semester	Changes [j, k]

(B) M.Sc. (Computer Science)

i.	First Semester	No Change
ii.	Second Semester	Minor Changes [b, c]
iii.	Third Semester	Changes [d, e, f, g, h, i]
iv.	Fourth Semester	Changes [j, k]

In the scheme of MCA/ M.Sc. (Computer Science) following changes were suggested.
(a) In MCA I Semester, weekly practical hours of **CS 413L "Computer Oriented Numerical and Statistical Methods Lab"** were proposed to be raised to 4 hrs./ week from 2 hrs./ week raising the credits of the course to 2 credits from 1 credit, and total semester credits to 26 credits from earlier 25 credits.
(b) In MCA IV/ M.Sc. (CS) II Semester, minor changes in the syllabus of **CS 302 "Data Communications and Networks"** were proposed.
(c) In MCA IV/ M.Sc. (CS) II Semester, weekly practical hours of **CS 432S "Seminar"** were proposed to be raised to 4 hrs./ week from 2 hrs./ week raising the

credits of the course to 2 credits from 1 credit, and total semester credits to 26 credits from earlier 25 credits w.e.f 2019-20.

(d) In MCA V/ M.Sc. (CS) III Semester, weekly practical hours of **CS 411L "Computer Graphics Lab"** were proposed to be reduced to 6 hrs./ week from 8 hrs./ week reducing the credits of the course to 3 credits from 4 credits (reducing total semester credits to 26 credits from earlier 28 credits) w.e.f 2019-20.

(e) In MCA V/ M.Sc. (CS) III Semester, weekly practical hours of **CS 508L "Big Data Analytics Lab"** were proposed to be reduced to 6 hrs./ week from 8 hrs./ week reducing the credits of the course to 3 credits from 4 credits (reducing total semester credits to 26 credits from earlier 28 credits). Also Lab Exercises were proposed to be added. w.e.f 2019-20.

(f) In MCA V/ M.Sc. (CS) III Semester, Elective – I was proposed to be replaced by **Discipline Elective** (the list of Discipline Elective courses is provided as part of the scheme). w.e.f 2021-22.

(g) In MCA V/ M.Sc. (CS) III Semester, Elective – II was proposed to be replaced by **Open Elective** to be chosen from other disciplines with prior permission of respective head and if the time table permits w.e.f 2021-22.

(h) In MCA V/ M.Sc. (CS) III Semester, minor changes in the syllabus **CS 511 "Cloud Computing"** (discipline elective course) was proposed w.e.f 2019-20.

(i) In MCA V/ M.Sc. (CS) III Semester, minor changes in the syllabus of **CS 601 "Cyber Security"** (discipline elective course) was proposed w.e.f 2019-20.

(j) Board recommended the following new reading elective courses (online) for MCA VI/ M.Sc. IV semester w.e.f 2019-20.

- **(i) Agile Software Development**
- **(ii) Organizational Behavior**
- **(iii) Software as a Service**
- **(iv) Blockchain**

(k) In MCA VI/ M.Sc. (CS) IV Semester, weekly practical hours of **CS 534P "UIL Project"** were proposed to be raised to 48 hrs./ week from 40 hrs./ week raising the credits of the course to 24 credits from 20 credits, and total semester credits to 26 credits from earlier 22 credits w.e.f 2019-20.

The Board reviewed the inclusion of Programme Educational Objectives, Programme Outcomes, and Learning Outcomes for all the Courses. The board also recommended modifying the format of *Suggested Books*, and inclusion of *Suggested E-Resources* in all the courses of MCA/ M.Sc. (CS).

Programme Educational Objectives, Program Outcomes and Programme Scheme of MCA/ M.Sc. (CS) is attached and marked as **Annexure-VII.**

The Course Details, including Course Code, Course Name, Learning Outcomes, Existing Syllabus, Revised Syllabus (if required) with Suggested Books and E-Resources, and Remarks for MCA/ M.Sc. (CS) courses is attached and marked as **Annexure-VIII.**

3 V M.Tech. (Computer Science)/ M.Tech. (Information Technology):

(A) M.Tech. (Computer Science)

i.	First Semester (2019-20)	Changes [a, b, f, g, h, i]
ii.	Second Semester (2019-20)	Changes [c, d, e, f, g, h, i]
iii.	Third Semester (2020-21)	Changes [j, k]
iv.	Fourth Semester (2020-21)	Changes [j, l]

(B) M.Tech. (Information Technology)

i.	First Semester (2019-20)	Changes [a, b, f, g, h, i]
ii.	Second Semester (2019-20)	Changes [c, d, e, f, g, h, i]
iii.	Third Semester (2020-21)	Changes [j, m]
iv.	Fourth Semester (2020-21)	Changes [j, n]

(a) Minor changes in the syllabus of **CS 431** "**Real Time Systems**" of M.Tech. (CS) I Semester were proposed.

(b) In M.Tech. (CS/ IT) I Semester, Elective – I and Elective – II were proposed to be replaced by **Discipline Elective – I** and **Discipline Elective – II** (the list of Discipline Elective courses is provided as part of the scheme).

(c) Minor Changes in the syllabus of **CS 505** "**Advanced Topics in Algorithms**" of M.Tech.(CS) II Semester were proposed.

(d) In M.Tech. (CS) II Semester, Elective – III and Elective – IV were proposed to be replaced by **Discipline Elective – III** and **Discipline Elective – IV**, and in M.Tech. (IT) II Semester, Elective – III was proposed to be replaced by **Discipline Elective – III** (the list of Discipline Elective courses is provided as part of the scheme).

(e) In M.Tech. (CS) II Semester, Elective – V was proposed to be replaced by **Open Elective**, and in M.Tech. (IT) II Semester, Elective – IV was proposed to be replaced by **Open Elective** (the Open Elective is to be chosen from other disciplines with prior permission of respective head and if the time table permits).

(f) Minor Changes in the syllabus of **CS 511** "**Cloud Computing**" (discipline elective course) of M.Tech. (CS/ IT) were proposed.

(g) Minor changes in the syllabus of **CS 302** "**Data Communications and Networks**" (discipline elective course) of M.Tech (CS/ IT) were proposed.

(h) The nomenclature of the course (discipline elective course) **CS 429** "**Pattern Recognition and Image Processing**" of M.Tech.(CS/ IT) was proposed to be changed to "**Digital Image Processing**".

(i) Board recommended the following new discipline elective courses for M.Tech. (CS/ IT):

(i) Big Data Analytics

(ii) Internet of Things

(j) Board recommended the following new reading elective courses (online) in M.Tech. (CS/ IT):

(i) Practical Machine Learning
(ii) Agile Software Development
(iii) Blockchain

(k) The nomenclature of the course **CS 604P "Project Part – I"** of M.Tech.(CS) III Semester was proposed to be changed to **"UIL Project Part – I"**.

(l) The nomenclature of the course **CS 605P "Project Part – II"** of M.Tech.(CS) IV Semester was proposed to be changed to **"UIL Project Part – II"**.

(m) The nomenclature of the course **CS 602P "Project Part – I"** of M.Tech.(IT) III Semester was proposed to be changed to **"UIL Project Part – I"**.

(n) The nomenclature of the course **CS 603P "Project Part – II"** of M.Tech.(IT) IV Semester was proposed to be changed to **"UIL Project Part – II"**.

The Board recommended the inclusion of Programme Educational Objectives, Programme Outcomes, and Learning Outcomes for all the Courses. The board also recommended modifying the format of *Suggested Books*, and inclusion of *Suggested E-Resources* in all the courses of M.Tech. (CS)/ M.Tech. (IT).

Programme Educational Objectives, Program Outcomes and Programme Scheme of M.Tech. (CS)/ M.Tech. (IT) is attached and marked as **Annexure-IX.**

The Course Details, including Course Code, Course Name, Learning Outcomes, Existing Syllabus, Revised Syllabus (if required) with Suggested Books and E-Resources, and Remarks for M.Tech. (CS)/ M.Tech. (IT) courses is attached and marked as **Annexure-X.**

3 VI Certificate/ Diploma/ Advanced Diploma:

(A) Certificate Course in Computer Programming and Application

The board discussed the syllabus of the course and suggested minor changes like inclusion of topics related to functions and pointers in 'C' language.

(B) Certificate Course in IT Localization

The board found that the syllabus of the course is up to the mark and **no change** was proposed.

(C) Certificate Course in Android Application Development

The board discussed the syllabus of the course and suggested that the course should be run as a Half-Session Course with both Module – I and Module – II merged

together with one single examination. The board also suggested some changes in the syllabus of the course.

(D) Diploma in Internet and Web Applications

Board discussed the syllabus of the course and suggested inclusion of CSS, JavaScript, PHP and Ajax.

(E) Diploma in Computer Hardware and Maintenance

The board discussed the syllabus of the course and suggested changes to accommodate recent developments in hardware and remove obsolete technologies from the syllabus.

(F) Diploma in .NET(C#, ASP.NET)

The board discussed the syllabus of the course and suggested minor changes in the syllabus. Also Lab Exercises are included in the syllabus.

(G) Diploma in Medical Image Processing

The board found that the syllabus of the course and suggested minor changes in the syllabus. Lab Exercises are included in the syllabus.

(H) Advanced Diploma in Medical Image Processing

The board discussed the syllabus of the course and suggested changes like inclusion of introduction to machine learning in image analysis. Also Lab Exercises are included in the syllabus.

(I) Advanced Diploma in Networking Examination

The board redesigned the syllabus in sections.

The Board reviewed the scheme of examination of all Certificate, Diploma and Advanced Diploma Courses and proposed changes in the minimum qualification criteria for admission, duration (Theory and Practical hours) and marking scheme of courses so as to make them consistent.

The Board suggested that the syllabus of all Certificate, Diploma and Advanced Diploma Courses should be structured having three sections.

The Board reviewed the inclusion of Learning Outcomes for Courses. The board also recommended modifying the format of *Suggested Books,* and inclusion of *Suggested E-Resources* in all Certificate/ Diploma/ Advanced Diploma Courses.

Programme Scheme of Certificate/ Diploma/ Advanced Diploma Courses is attached and marked as **Annexure-XI.**

The Course Details, including Course Name, Learning Outcomes, Existing Syllabus, Revised Syllabus (if required) with Suggested Books and E-Resources, and Remarks

for Certificate/ Diploma/ Advanced Diploma Courses is attached and marked as **Annexure-XII.**

4. The board reviewed the Study/ Curricula, scheme of examination for the courses running in programmes under departments other than Computer Science. No changes were proposed by the concerned departments and as such no changes in these courses were proposed by the Board.

The Board recommended the inclusion of Learning Outcomes, *Suggested Books*, and *Suggested E-Resources* along with Existing Syllabus in all of these Courses which are attached and marked as **Annexure-XV.**

5. Board reviewed the reports received from the examiners of different examinations of 2017 and 2018. Most of the examiners reported that the answers were "to the point" and "satisfactory" with some examiners reporting vague and diffused answers (nine in number). The analysis of the reports received is enclosed in **Annexure–XIII**.

6. The board reviewed the report of question papers of periodical tests end semester (final) examinations held up to 2017-18. The questions were subjectively categorized based on their difficulty level as low, medium and high. It was found that in most of the question papers a balance was kept between the different difficulty levels of questions, with around 40% of questions labeled as easy, 40% as medium, and 20% as hard. The analysis is enclosed in **Annexure–XIVA and XIVB**.

Meeting ended with vote of thanks.

Name of Programme: BCA

Programme Educational Objectives

The main objectives of the programme are:

- Design; develop application using programming languages that fulfill the needs with appropriate societal considerations and environmental aspects.
- Integrate and apply efficiently the contemporary IT tools to all computer applications.
- Solve and work with a professional context pertaining to ethics, society, culture, environment and business.
- Involve in perennial learning for a continued career development and progress as a computer professional.
- Communicate effectively and present technical information in oral and written reports
- Function competently as an individual and as a leader in multidisciplinary projects to demonstrate computing and management skills
- Create and design innovative methodologies to solve complex problems for the betterment of the society
- Apply the inherent skills with absolute focus to function as a successful entrepreneur
- BCA graduates will exhibit effective work ethics and be able to adapt the challenges of a dynamic job environment.
- Acquire proficiency in the basic mathematics, statistics and probability employed in Computer Science.

Programme Outcomes

After completion of the course, the student will achieve the following:

- PO1. Domain Knowledge: Apply the knowledge of mathematics, strong fundamental concepts on data structures, database technologies, programming such as C, C++, Java, COBOL, etc., networking, multimedia in the modeling and design of IT applications. Also apply the knowledge gained on laboratory experiments.
- PO2. Problem analysis: Identify, formulate, and analyze existing algorithms for different real life problems using different domain knowledge
- PO3. Design/development of solutions: Design, develop, test and maintain desktop, web and cross platform software applications using modern tools and technologies that are technically sound, economically feasible, socially and industrially acceptable.
- PO4. Analyzing Complex problems: Use domain based knowledge to function effectively on various problems to achieve a common goal to provide effective solutions for complex real life problems using limited resources.
- PO5. Usage of Modern IT tools: Use MS Office tools such as Word, Excel, PowerPoint and Access for computing, analysis and interpretation of data and simulation tools for problem solving in different computer application domain.
- PO6. The Professional and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional computer applications.
- PO7. Environment and sustainability: Understand the impact of the professional computer applications in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10. Communication: Exhibit the critical thinking and communication skills required to enable the graduate to communicate business ideas to senior management and general public.
- PO11. Project Management: Demonstrate knowledge of the computer application and management principles to apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change

Programme Scheme: BCA

Semester I

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 107	Computer Fundamentals and Programming	6	0	0	6
CS 107L	Computer Fundamentals and Programming Lab	0	0	8	4
	Total:	6	0	8	10

Proposed					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Computer Fundamentals and Programming	6	0	0	6
	Computer Fundamentals and Programming Lab	0	0	8	4
	Total:	6	0	8	10

Semester II

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 103	Computer Architecture and Object Oriented Programming	6	0	0	6
CS 103L	Computer Architecture and Object Oriented Programming Lab	0	0	6	3
	Total:	6	0	6	9

Proposed					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Computer Architecture and Object Oriented Programming	6	0	0	6
	Computer Architecture and Object Oriented Programming Lab	0	0	6	3
	Total:	6	0	6	9

Semester III

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 208	Computer Oriented Numerical and Statistical Methods	6	0	0	6
CS 208L	Computer Oriented Numerical and Statistical Methods Lab	0	0	4	2
CS 211	Data Structures	6	0	0	6
CS 211L	Data Structures Lab	0	0	8	4
	Total:	12	0	12	18

Proposed					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Computer Oriented Numerical and Statistical Methods	6	0	0	6
	Computer Oriented Numerical and Statistical Methods Lab	0	0	4	2
	Data Structures	6	0	0	6
	Data Structures Lab	0	0	8	4
	Total:	12	0	12	18

Semester IV

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 201	Application Software and Visual Computing	6	0	0	6
CS 201L	Application Software and Visual Computing Lab	0	0	4	2
CS 206	Business Data Processing	6	0	0	6
CS 206L	Business Data Processing Lab	0	0	6	3
CS 215	Systems Programming	6	0	0	6
	Total:	18	0	10	23

Proposed					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Application Software and Visual Computing	6	0	0	6
	Application Software and Visual Computing Lab	0	0	6	3
	Business Data Processing	6	0	0	6
	Business Data Processing Lab	0	0	6	3
	Systems Programming	6	0	0	6
	Total:	18	0	10	23

Semester V

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
5.1	Database Management Systems	6	0	0	6
5.2	Database Management Systems Lab	0	0	4	2
5.3	Java Programming Applications	6	0	0	6
5.4	Java Programming Applications Lab	0	0	8	4
	Total:	12	0	12	18

Proposed					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by office	Discipline Elective – I	6	0	0	6
	Discipline Elective – I Lab	0	0	4	2
	Programming in Java	6	0	0	6
	Programming in Java Lab	0	0	8	4
	Total:	12	0	12	18

Semester VI

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
6.1	Communication and Networking	6	0	0	6
6.2	Multimedia and Web Designing	6	0	0	6
6.3	Multimedia & Web Designing Lab	0	0	6	3
6.4	Project Lab	0	0	6	3
	Total:	12	0	12	18

Proposed					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Discipline Elective – II	6	0	0	6
	Multimedia and Web Designing	6	0	0	6
	Multimedia & Web Designing Lab	0	0	6	3
	Project Lab	0	0	6	3
	Total:	12	0	12	18

Discipline Electives – I

Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Operating Systems	6	0	0	6
	Database Management Systems	6	0	0	6
	Web Development and .NET Framework	6	0	0	6

Discipline Electives – II

Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Communication and Networking	6	0	0	6
	System Analysis and Design	6	0	0	6
	Cloud Computing	6	0	0	6

Discipline Electives – I Lab

Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Operating Systems Lab	0	0	4	2
	Database Management Systems Lab	0	0	4	2
	Web Development and .NET Framework Lab	0	0	4	2

Name of Programme: BCA

Course Details:

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1	**CS 107 Computer Fundamentals and Programming**	On successful completion of the course students will be able to • Develop conceptual understanding of input and output devices of computers and how it works and recognize the basic terminology used in computer programming • Develop the ability to write, compile and debug programs in C language and use different data types for writing the programs. • Formulate the programs based on structures, loops and functions. • Conceptualize the understating of differentiating between call by value and call by reference. • Develop the conceptual understanding of the dynamic behavior of memory by the use of pointers.		**Suggested Books** 1. Sinha, P. K., & Sinha, P. BPB Publication. *Computer Fundamental*, Third Edition-2005. 2. Mano, M. M. (2003). *Computer system architecture.Prentice*-Hall of India. 3. Balagurusamy, E. (2012). *programming in ANSI C*. Tata McGraw-Hill Education. 4. VenugopalK.R., *Programming with C*, Tata Mcgraw-Hill Publishing Company Limited. 5. Kergnighan Brian W., Ritchie Dennis M., *The C Programming Language*, Pearson Education, 2nd Edition, New Delhi Prentice Hall. 6. Kanetkar, Y. P. (2016). *Let us C*. BPB publications. **Suggested E-Resources:** 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/	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
2	**CS 107L Computer Fundamentals and Programming Lab**	On successful completion of the course students will be able to • Understand the concept of C programming language, syntax and semantic rules, data types program structure, control structures and other features available for writing programs. • Write program using C language and compiling, debugging and execution. • Develop programs using features of C Language: control structure, array, structures, pointer, and functions, file handling. • Develop programs for searching, sorting, merging and others application. • Develop application for real life problem for record keeping and maintenance.			

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
3.	**CS 103 Computer Architecture and Object Oriented Programming**	On successful completion of the course students will be able to • Equip the students to meet the requirement of corporate world and Industry standard. • Engage in professional development and to pursue graduate education in the fields of Information Technology and Computer Applications • Apply computing principles and business practices in software solutions, outsourcing services, public and private sectors • Apply C++ features to program design and implementation. • Explain object-oriented concepts and describe how C++ including identifying the features and Peculiarities of the C++ programming language support them. • Use C++ to demonstrate practical experience in developing object-oriented solutions	**Recommended Books** 1. Mano, M. M. (2002). *Digital design*. EBSCO Publishing, Inc... 2. Mano, M. M. (2003). *Computer system architecture.Prentice*-Hall of India. 3. Balagurusamy, E. (2001). *Object Oriented Programming with C++, 6e*. Tata McGraw-Hill Education. 4. Schildt, H. (2003). *C++: The complete reference.* McGraw-Hill.. 5. Hafez, A. A. (1988). Computer architecture and organization 6. Venugopal, K. R. (2013). *Mastering C++*.Tata McGraw-Hill Education. 7. Lafore, R. (2001). *Object-oriented programming in Turbo C++*.Galgotia publications. 8. Stroustrup, B. (2000). *The C++ programming language*. Pearson Education India.. 9. Kumar K., Programming with C++ Made Simple. **Recommended E-Resources:** 1. Programming in C++ https://nptel.ac.in/courses/106105151/ 2. Computer Organizations and Architecture https://nptel.ac.in/courses/106103068/ 3. Stallings, W. (2003). *Computer organization and architecture: designing for performance*. Pearson Education India. http://williamstallings.com/ComputerOrganization/	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
4.	**CS 103L Computer Architecture and Object Oriented Programming**	On successful completion of the course students will be able to • Understand the concept of C++ programming language, syntax and semantic rules, data types program structure, control structures and other features available for writing programs. • Write object oriented programs using C++ language its compiling, debugging and execution. • Apply C++ features to program design and implementation. • Use C++ to demonstrate practical experience in developing object-oriented solutions to real life problems.	**Recommended 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. Venugopal, K. R. (2013). *Mastering C++*.Tata McGraw-Hill Education. 4. Lafore, R. (2001). *Object-oriented programming in Turbo C++*.Galgotia publications. 5. Stroustrup, B. (2000). *The C++ programming language*. Pearson Education India.. 6. Kumar K., Programming with C++ Made Simple. **Recommended E-Resources:** 1. Programming in C++ https://nptel.ac.in/courses/106105151/	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
5..	**CS 208 Computer Oriented Numerical and statistical Method**	On successful completion of the course students will be able to • Apply numerical methods to obtain approximate solutions to mathematical problems. • Using appropriate numerical methods, determine the solutions to given non-linear equations, systems of linear equations, interpolation, numerical differentiation and integration and numerical solution of ordinary differential equations. • Analyze the errors obtained in the numerical solution of problems. • Apply appropriate algorithms to solve selected problems, both manually and by writing computer programs. • Compare different algorithms with respect to accuracy and efficiency of solution. • Implement numerical methods algorithm using programming language.	**Recommended Books** 1. Rajaraman, V. (2004) Computer Oriented Numerical Methods.. 2. Sastry, S. S. (2012). *Introductory methods of numerical analysis*. PHI Learning Pvt. Ltd.. 3. Gupta, S. P. (1994). *Statistical Methods*, Sultan Chand & Sons, New Delhi 4. Gupta, S. C., & Kapoor, V. K. (1997). *Fundamentals of Mathematical Statistics*, Ninth Extensively.Revised Edition, Sultan Chand & Sons. 5. Grewal, B. S. (2018). Numerical Methods in Engineering and Science:(C, and C++, and MATLAB). Stylus Publishing, LLC. 6. Krishnamurthy, E. V., & Sen, S. K. Numerical Algorithms: Computations in Science and Engineering. 2001. Affiliated East-West Press, New Delhi. 7. GovilR., *Kamputer se sankhyatmakReetiyan*, et.al. Pitamber Publications, New Delhi 8. Krishnamurthy, E. V., & Sen, S. K. (1976). *Computer-based numerical algorithms*.East-West Press. 9. Rao, K. S. (2017). *Numerical methods for scientists and engineers*. PHI Learning Pvt. Ltd.. 10. Yule, G. U., & Kendall, M. G. (1987). *An Introduction to the Theory of Statistics* Universal Book Stall. *New Delhi*. 11. Agarwal, B. L. (2006). *Basic statistics*.New Age International. 12. Govil R. *Kamputer se sankhyatmakReetiyan*, et.al. Pitamber Publications, New Delhi **Recommended E-Resources:** 1. Numerical methods and programming https://nptel.ac.in/courses/122106033/	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
6.	**CS 208L Computer Oriented Numerical and statistical Method Lab**	On successful completion of the course students will be able to • Apply appropriate algorithms to solve non-linear equations, linear equations, interpolation, numerical differentiation, integration, numerical solution of ordinary differential equations problems numerical problems. • Develop C programs based on algorithms of different numerical methods for solving the numerical problems. • Debugging and Testing of programs based on sample data of numerical problems. • Analyze the output and the errors obtained in the solution of numerical problems.	**Recommended Books** 2. Rajaraman, V. (2004) Computer Oriented Numerical Methods.. 3. Grewal, B. S. (2018). Numerical Methods in Engineering and Science:(C, and C++, and MATLAB). Stylus Publishing, LLC. 4. Krishnamurthy, E. V., & Sen, S. K. Numerical Algorithms: Computations in Science and Engineering. 2001. Affiliated East-West Press, New Delhi. **Recommended E-Resources:** 2. Numerical methods and programming https://nptel.ac.in/courses/122106033/	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
7.	**CS 211** **Data Structures**	On successful completion of the course students will be able to • choose appropriate data structure as applied to specified problem definition. • handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures. • apply concepts learned in various domains like DBMS, compiler construction etc. • use linear and non-linear data structures like stacks, queues , linked list etc.	**Recommended Books** 1. Ullman, J. D., Aho, A. V., & Hopcroft, J. E. (1974). *The design and analysis of computer algorithms*. Addison-Wesley, Reading, 4, 1-2. 2. Tremblay, J. P., & Sorenson, P. G. (1976). *An introduction to data* structures with applications. McGraw-Hill Computer Science Series, New York: McGraw-Hill, 1976.. 3. Knuth D.E., Fundamental Algorithms (The Art of Comp. Prog. Vol. *1),* Narosa Publishing House, New Delhi 4. Horowitz, E. (2006). *Fundamentals of data structures in C++*.Galgotia Publications. 5. Tenenbaum, A. M. (1990). *Data structures using C*. Pearson Education India. 6. Kruse, R., &Tondo, C. L. (2007). *Data structures and program design in C*. Pearson Education India. 7. Lipschutz, S. (1987). *Schaum's Outline of Data Structure*. McGraw-Hill, Inc... **Recommended E-Resources:** 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/	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
8.	**CS 211L** **Data Structures Lab**	On successful completion of the course students will be able to • Develop program for the implementation of lineal and non-linear data structures. • Develop another program using the different data structures and their testing. • Implementation of searching, insertion, deletion, traversing mechanism etc. on various data structures. • apply concepts learned in implementation of compiler construction, lexical analysis etc.	**Recommended Books** 1. Ullman, J. D., Aho, A. V., & Hopcroft, J. E. (1974). *The design and analysis of computer algorithms*. Addison-Wesley, Reading, 4, 1-2. 2. Tremblay, J. P., & Sorenson, P. G. (1976). *An introduction to data* structures with applications. McGraw-Hill Computer Science Series, New York: McGraw-Hill, 1976.. 3. Horowitz, E. (2006). *Fundamentals of data structures in C++*.Galgotia Publications. 4. Tenenbaum, A. M. (1990). *Data structures using C*. Pearson Education India. 5. Kruse, R., &Tondo, C. L. (2007). *Data structures and program design in C*. Pearson Education India. 6. Lipschutz, S. (1987). *Schaum's Outline of Data Structure*. McGraw-Hill, Inc... **Recommended E-Resources:** 3. Programming and Data Structures https://swayam.gov.in/course/1407-programming-and-data-structures 4. Data Structures and Program Methodology https://nptel.ac.in/courses/106103069/	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
9.	**CS 201 Application Software & Visual Computing**	On successful completion of the course students will be able to • Familiarity with windows environment while practicing on Windows • Achieve operator skills in MS-Word, MS-Excel and MS-PowerPoint. • Understand basic concepts of database system and its use as backend (MS-Access) in a project at any level. • Gain knowledge of visual programming through VB.NET as a programming language in .NET framework. • Develop a small (minor) project.	**Recommended Books** 1. Deitel, H. M., Deitel, P. J., & Nieto, T. R. (2001). *Visual Basic.Net with Cdrom*.Prentice Hall PTR. 2. Platt, D. S. (2002). *Introducing Microsoft. Net*. Microsoft press. 3. Esposito, D. (2011). *Programming Microsoft ASP.net 4*. Pearson Education. 4. Developing XML Web Services Using Microsoft® ASP.NET - Microsoft- Microsoft Press 5. Reilly, D. J. (2002). *Designing microsoft asp. net applications*. Microsoft Press. 6. Ryan, D., & Ryan, T. (2001). ASP. NET: Your Visual Blueprint for Creating Web Applications on the. Net Framework. John Wiley & Sons, Inc.. **Recommended E-Resources** 1. W3Schools website https://www.w3schools.com/asp/ 2. Grundgeiger, D. (2018). *Programming Visual Basic. NET*. O'Reilly. https://www.visualchart.com/ContentManagement/Development/Manuals/EN/vbNet_programming.pdf	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
10.	**CS 201L Application Software & Visual Computing Lab**	On successful completion of the course students will be able to • Work on windows environment and applications running application on it. • Achieve operator skills application software MS-Word, MS-Excel and MS-PowerPoint. • Implementation of concepts of database system, creation, insertion, updation of database and query operations. • Able to create and use database as backend (MS-Access) in development of database related project. • Implementation of GUI programs using VB.NET programming language	**Recommended Books** 7. Deitel, H. M., Deitel, P. J., & Nieto, T. R. (2001). *Visual Basic.Net with Cdrom*.Prentice Hall PTR. 8. Platt, D. S. (2002). *Introducing Microsoft. Net*. Microsoft press. 9. Esposito, D. (2011). *Programming Microsoft ASP.net 4*. Pearson Education. 10. Developing XML Web Services Using Microsoft® ASP.NET - Microsoft- Microsoft Press 11. Reilly, D. J. (2002). *Designing microsoft asp. net applications*. Microsoft Press. 12. Ryan, D., & Ryan, T. (2001). ASP. NET: Your Visual Blueprint for Creating Web Applications on the. Net Framework. John Wiley & Sons, Inc.. **Recommended E-Resources** 3. W3Schools website https://www.w3schools.com/asp/ 4. Grundgeiger, D. (2018). *Programming Visual Basic. NET*. O'Reilly. https://www.visualchart.com/ContentManagement/Development/Manuals/EN/vbNet_programming.pdf	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
11.	**CS 206 Business Data Processing**	On successful completion of the course students will be able to • Develop Business applications in Cobol. • Identify all peripheral devices. • Prepare of all documents developed during system development	**Recommended Books** 1. Clifton, H. D. (1974). *Systems analysis for business data processing*. 2. Orilla, An Introduction to Business Data Processing, Mc Graw Hill 3. Roy, M. K., & Dastidar, D. G. (1989). *COBOL Programming*. Tata McGraw-Hill Education. 4. Awad, E. M. (1985). *Systems Analysis and Design*. 5. Irwin, R. D., .Stern, N. B., & Stern, R. A. (1985). *Structured COBOL Programming*. John Wiley & Sons. **Recommended E-Resources** 1. COBOL Programming http://www.csis.ul.ie/cobol/course/Default.htm 2. Norton, P. (2002). *Introduction to computers*. McGraw Hill. https://onlinestudy4u.files.wordpress.com/2012/10/introduction-to-computers-by-peter-norton-6th-ed.pdf	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
12.	**CS 206L Business Data Processing Lab**	On successful completion of the course students will be able to • Develop code based on formula, selection and iteration. • Perform operation insertion, deletion, searching, sorting on table. • Apply search, searchall, sort and merge verb. • Implement code which does updating in sequential, relative and indexed sequential file. • Able to write subroutine in COBOL.	**Recommended Books** 1. Irwin, R. D., .Stern, N. B., & Stern, R. A. (1985). *Structured COBOL Programming*. John Wiley & Sons. **Recommended E-Resources** 3. COBOL Programming http://www.csis.ul.ie/cobol/course/Default.htm 4. Norton, P. (2002). *Introduction to computers*. McGraw Hill. https://onlinestudy4u.files.wordpress.com/2012/10/introduction-to-computers-by-peter-norton-6th-ed.pdf	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
13.	**CS 215 System Programming**	On successful completion of the course students will be able to • To define the basics of system programs like editors, compiler, assembler, linker, loader, interpreter and debugger. • Define how computer and operating system handles the memory. • Describe the various concepts of assemblers and microprocessors. • To analysis the various phases of compiler and compare its working with assembler. • To examine how linker and loader create an executable program from an object module created by assembler and compiler. • To identify various editors and debugging techniques	**Recommended Books** 1. Donovan,J.J.,& International Student edition. (1972). *Systems programming* (Vol. 3, No. 5). New York: McGraw-Hill. 2. Das, S. (2005). *Your UNIX: The ultimate guide*. McGraw-Hill, Inc.. 3. Duncan, R. (1988). *Advanced MS-DOS Programming* (p. 309). Redmond, WA: Microsoft Press. 4. Ellzee, *System Software*, Science Research Association. 5. Bose, S. K. (1996). *Hardware and Software of Personal Computers*. New Age International.. 6. Biggerstaff T.J., *System Software Tools*, Pentrice - Hall.. 7. Aho, A. V., & Ullman, J. D. (1977). *Principles of Compiler Design (Addison-Wesley series in computer science and information processing)*. Addison-Wesley Longman Publishing Co., Inc..,. 8. Kanetkar, Y. P. (1996). *Unix shell programming*. BPB Publ... 9. Dhamdhere, D. M. (1999). *Systems Programming and Operating Systems*. Tata McGraw-Hill. 10. Beck, L. L. (1997). *System software: an introduction to systems programming*. Addison-Wesley **Recommended E-Resources** 1. System Programming http://solomon.ipv6.club.tw/Course/SP.941/	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
14.	**CS 303 Database Management Systems**	On successful completion of the course students will be able to • Describe data models and schemas in DBMS • Learn the features of database management systems and Relational database. • Use SQL-the standard language of relational databases. • Learn the functional dependencies and design of the database. Learn the concept of Transaction and Query processing	**Recommended Books** 1. Silberschatz, A., Korth, H. F., &Sudarshan, S. (1997). *Database system concepts* (Vol. 4). New York: McGraw-Hill. 2. Date C.J, An Introduction to Database systems, Addison Wesley 3. Elmasri, R., &Navathe, S. (2003). *Fundamentals of Database Systems* Addison Wesley. *Reading, MA.* 4. Majumdar&Bhattachrya, *Database Management System*, Tata McGraw-Hill 5. Ramakrishna, Gehkre, *Database Management System*, Tata Mc Graw- Hill ~~6.~~ Leon, A., & Leon, M. (2010). *Database management systems*.Vikas Publishing House Pvt. Limited 7. Ullman, J. D. (1984). *Principles of database systems*.Galgotia publications 8. Shah, N. (2016). *Database Systems Using Oracle*. Pearson Education India 9. Martin, J. (1977). *Computer database organization*. Prentice Hall PTR **Recommended E-Resources** 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	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
15.	**CS 303L Database Management Systems Lab**	On successful completion of the course students will be able to • Create; define database/ table using the database tool Oracle. • Implementation of DDL and DML command on database. • Implementation of SQL queries operations on database • Implementation of referential integrity and operations on multiple tables. • work easily with Oracle database	**Recommended Books** 1. Shah, N. (2016). *Database Systems Using Oracle*. Pearson Education India 2. Gupta, P. K. D., & KRISHNA, P. R. (2013*). Database management system Oracle SQL and PL/SQL*. PHI Learning Pvt. Ltd **Recommended E-Resources** 1. Data Base Management System https://nptel.ac.in/courses/106105175/ 2. Database Management Essentials https://www.coursera.org/learn/database-management	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
16.	**CS 305** **Programming in Java**	On successful completion of the course students will be able to • Apply Object oriented features to program design and implementation. • Explain object-oriented concepts and describe how Java including identifying the features and peculiarities of the Java programming language supports them. • Use Java to demonstrate practical experience in developing object-oriented solutions using graphical components	**Recommended Books** 1. Bhave, M. P., &Patekar, S. A. (2009). *Programming with Java*. Pearson Education. 2. Kahate, *Java Programming*. Oxford 3. Balagurusamy, E., & Hirshfield, S. (2000). *Programming with java*. Tata McGraw-Hill. 4. Mughal, K. A., & Rasmussen, R. W. (2016). *A Programmer's Guide to Java SE 8 Oracle Certified Associate (OCA*). Addison-Wesley Professional. 5. Arnold, K., Gosling, J., & Holmes, D. (2005). *The Java programming language*.Addison Wesley Professional. 6. Zukowski, J. (1998). *Mastering Java 2*. SYBEX Inc.. 7. Deitel, P., &Deitel, H. (2011). *Java How to program*. Prentice Hall Press. 8. Horstmann, C. S., & Cornell, G. (2002). *Core Java 2: Volume I, Fundamentals*. Pearson Education. 9. Schildt, H. (2007). *Java: the complete reference*. McGraw-Hill. **Recommended E-Resources** 3. Java Lectures https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html 4. Object Oriented Programming in Java Specialization https://www.coursera.org/specializations/object-oriented-programming	**No Change**	The title of the paper changed from Java Programming Applications To Programming in Java

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
17	**CS 305L** **Programming in Java**	On successful completion of the course students will be able to • Apply Object oriented features to program design and implementation. • Implement the core java programs. • Implement the web application using java tools. • Develop the GUI application using applet, AWT, and other packages. • Develop database applications using database connectivity and design the websited.	**Recommended Books** 10. Bhave, M. P., &Patekar, S. A. (2009). *Programming with Java*. Pearson Education. 11. Kahate, *Java Programming*. Oxford 12. Balagurusamy, E., & Hirshfield, S. (2000). *Programming with java*. Tata McGraw-Hill. 13. Mughal, K. A., & Rasmussen, R. W. (2016). *A Programmer's Guide to Java SE 8 Oracle Certified Associate (OCA)*. Addison-Wesley Professional. 14. Arnold, K., Gosling, J., & Holmes, D. (2005). *The Java programming language*.Addison Wesley Professional. 15. Zukowski, J. (1998). *Mastering Java 2*. SYBEX Inc.. 16. Deitel, P., &Deitel, H. (2011). *Java How to program*. Prentice Hall Press. 17. Horstmann, C. S., & Cornell, G. (2002). *Core Java 2: Volume I, Fundamentals*. Pearson Education. 18. Schildt, H. (2007). *Java: the complete reference*. McGraw-Hill. **Recommended E-Resources** 5. Java Lectures https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html 6. Object Oriented Programming in Java Specialization https://www.coursera.org/specializations/object-oriented-programming	**No Change**	The title of the paper changed from Java Programming Applications Lab To Programming in Java Lab

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
18.	**CS 301 Communication & Networking**	On successful completion of the course students will • Be able to demonstrate knowledge of the network and its application areas. • Have the ability to use various networks protocols. • Have an understanding of the proper contents of a data communication and networking	**Recommended Books** 1. Stallings, W. (2007). *Data and computer communications*. Pearson Education India. 2. Forouzan, A. B. (2007*). Data communications & networking*. Tata McGraw-Hill Education. 3. Tanenbaum, A. S., & Wetherall, D. (2014). *Computer networks.* Harlow, Essex: Pearson,. 4. Martin, J. (1978). *Computer networks and distributed processing*. **Recommended E-Resources** 1. Kurose, J. F., & Ross, K. W. (2009). *Computer networking: a top-down approach*. Boston: Addison Wesley. https://www.bau.edu.jo/UserPortal/UserProfile/PostsAttach/10617_1870_1.pdf 2. Data Communication https://nptel.ac.in/courses/106105082/	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
19.	**CS 307 Multimedia & Web Design**	On successful completion of the course students will be able to • Design and develop a static and dynamic website • Use java script to add dynamic content to website. • Analyze the various latest interactive multimedia devices and the basic concepts about images and image format. • Discuss various multimedia tools like Photoshop, Flash. • Design interactive multimedia software using multimedia tools(Photoshop, Flash) and web programming languages (HTML, CSS, Java Script, PHP)	**Recommended Books** 1. Ray, D. S. *Mastering HTML* 4.0, 1997. Sybex, San Francisco, CA, USA 2. Bayross, I. *Web Enabled Commercial Application Development by using HTML, Java Script, DHTML and PHP* 3. Reinhardt, R. (2004). *Flash Mx 2004 Action Script Bible*.John Wiley & Sons. 4. Bangia, R. (2004). *Multimedia and Web Technology*. Firewall Media. 5. Alexis, L., & Mathews, L. (1997). *Internet for everyone* 6. Wirasinha, A. (2002). *Flash in a Flash: Web Development*. Prentice-Hall of India. 7. Jeffcoate, J. (1995). *Multimedia in practice: technology and applications*. Prentice-Hall, Inc.. 8. Holzner, S. (2007). *PHP: the complete reference*. Tata McGraw-Hill Education. **Recommended E-Resources** 1. W3Schools website https://www.w3schools.com/ 2. Internet Technology https://nptel.ac.in/courses/106105084/13	**No Change**	

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
20.	**CS 307L Multimedia & Web Design Lab**	On successful completion of the course students will be able to • Write program to develop a static and dynamic website • Use java script to add dynamic content to website. • Analyze the various latest interactive multimedia devices and the basic concepts about images and image format. • Design interactive multimedia software using multimedia tools(Photoshop, Flash) and web programming languages (HTML, CSS, Java Script, PHP)	**Recommended Books** 9. Ray, D. S. *Mastering HTML* 4.0, 1997. Sybex, San Francisco, CA, USA *10.* Bayross, I. *Web Enabled Commercial Application Development by using HTML, Java Script, DHTML and PHP* 11. Reinhardt, R. (2004). *Flash Mx 2004 Action Script Bible*.John Wiley & Sons. 12. Bangia, R. (2004). *Multimedia and Web Technology*. Firewall Media. 13. Alexis, L., & Mathews, L. (1997). *Internet for everyone* 14. Wirasinha, A. (2002). *Flash in a Flash: Web Development*. Prentice-Hall of India. 15. Jeffcoate, J. (1995). *Multimedia in practice: technology and applications*. Prentice-Hall, Inc.. 16. Holzner, S. (2007). *PHP: the complete reference*. Tata McGraw-Hill Education. **Recommended E-Resources** 3. W3Schools website https://www.w3schools.com/ 4. Internet Technology https://nptel.ac.in/courses/106105084/13	**No Change**	

* Matter in contrast (black background & white letters) is shifted to some other units, and material brought as a result of shift is also in contrast.
# Matter in square brackets, bold, italic and crossed is deleted.
@ Proposed added materials are shaded in grey.

Name of Programme: B.Sc. (Mathematics) [Computer Science]

Semester I

Existing Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 107	Computer Fundamentals and Programming	6	0	0	6
CS 108L	Computer Fundamentals and Programming Lab	0	0	4	2
Total					

Proposed Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Computer Fundamentals and Programming	6	0	0	6
	Computer Fundamentals and Programming Lab	0	0	4	2
Total					

Semester II

Existing Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 103	Computer Architecture and Object Oriented Programming	6	0	0	6
CS 104L	Computer Architecture and Object Oriented Programming Lab	0	0	4	2
Total					

Proposed Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Computer Architecture and Object Oriented Programming	6	0	0	6
	Computer Architecture and Object Oriented Programming Lab	0	0	4	2
Total					

Semester III

Existing Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 210	Data Structures	6	0	0	6
CS 210L	Data Structures Lab	0	0	4	2
Total					

Proposed Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Data Structures	6	0	0	6
	Data Structures Lab	0	0	4	2
Total					

Semester IV

Existing Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 208	Computer Oriented Numerical and Statistical Methods	6	0	0	6
CS 208L	Computer Oriented Numerical and Statistical Methods Lab	0	0	4	2
Total					

Proposed Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Computer Oriented Numerical and Statistical Methods	6	0	0	6
	Computer Oriented Numerical and Statistical Methods Lab	0	0	4	2
Total					

Semester V

Existing Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**

Proposed Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**

5.1	Business Data Processing and Database Management System	6	0	0	6
5.2	Business Data Processing and Database Management System Lab	0	0	4	2
Total					

To be filled by the office	Discipline Elective – I	6	0	0	6
	Discipline Elective – I Lab	0	0	4	2
Total					

Semester VI

Existing Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
6.1	Communication and Networking	6	0	0	6
6.2	Communication and Networking Lab	0	0	4	2
Total					

Proposed Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Discipline Elective – II	6	0	0	6
	Project Lab	0	0	4	2
Total					

Discipline Electives – I

Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Programming in Java	6	0	0	6
	Business Data Processing and Database Management System	6	0	0	6
	Web Development and .NET Framework	6	0	0	6

Discipline Electives – II

Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Communication and Networking	6	0	0	6
	Systems Programming	6	0	0	6

Discipline Electives – I Lab

Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Programming in Java Lab	0	0	4	2
	Business Data Processing and Database Management System Lab	0	0	4	2
	Web Development and .NET Framework Lab	0	0	4	2

Name of Programme: B.Sc. Mathematics (Computer Science)

Course Details:

Semester: I

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1	CS 107 Computer Fundamentals and Programming (CFP)	After completion of this course student will be able to • make a conceptual understanding of input and output devices of computers and how it works and recognize the basic terminology used in computer programming • develop the ability to write, compile and debug programs in C language and use different data types for writing the programs. • formulate the programs based on structures, loops and functions. • conceptualize the understating of differentiating between call by value and call by reference. • develop the conceptual understanding of the dynamic behavior of memory by the use of pointers.	--	-- **Suggested Books:** 1. Sinha, P. K., & Sinha, P. BPB Publication. *Computer Fundamental*, Third Edition-2005, 12.. 2. Mano, M. M. (2003). *Computer system architecture*.*Prentice*-Hall of India. 3. Norton, P. (1989). *Peter Norton's DOS guide*. Brady. 4. Balagurusamy, E. (2012). *programming in ANSI C*. Tata McGraw-Hill Education. 5. VenugopalK.R., *Programming with C*, Tata Mcgraw-Hill Publishing Company Limited. 6. Hayes John P., *Computer Architecture and Organization*, Tata McGraw Hill, New Delhi, 1998. 7. RAM B., *Computer Fundamentals*, Architecture & Organization, New Age International, New Delhi. 8. Kergnighan Brian W., Ritchie Dennis M., *The C Programming Language*, Pearson Education, 2nd Edition, New Delhi Prentice Hall. 9. Kanetkar, Y. P. (2016). *Let us C*. BPB publications..	

				10. Gottfried, B. (1996). *Programming with C*, Schaum's Outlines **Suggested E-Resources:** 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/	
2	CS 107L Computer Fundamentals and Programming (CFP) Lab	After completion of this course student will be able to • Develop a practical understanding to write, compile and debug programs in C language and use different data types for writing the programs. • Develop analytical skills to write the programs based on structures, loops and functions. • conceptualize the understating of differentiating between call by value and call by reference. • develop the conceptual understanding of the dynamic behavior of memory by the use of pointers.	--	--	

Semester: II

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1	CS 103 Computer Architecture and Object Oriented Programming	On successful completion of this course, Student will be able to • To equip the students to meet the requirement of corporate world and Industry standard. • To engage in professional development and to pursue graduate education in the fields of Information Technology and Computer Applications • To provide the students about computing principles and business practices in software solutions, outsourcing services, public and private sectors • Apply C++ features to program design and implementation.	--	**Suggested Books:** 1. Mano, M. M. (2002). Digital design. EBSCO Publishing, Inc... 2. Mano, M. M. (2003). *Computer system architecture.Prentice*-Hall of India. 3. Balagurusamy, E. (2001). *Object Oriented Programming with C++, 6e*. Tata McGraw-Hill Education. 4. Schildt, H. (2003). *C++: The complete reference.* McGraw-Hill.. 5. Venugopal, K. R. (2013). *Mastering C++*.Tata McGraw-Hill Education. 6. Lafore, R. (2001). *Object-oriented programming in Turbo C++*.Galgotia publications. 7. Stroustrup, B. (2000). *The C++ programming language*. Pearson Education India.. **Suggested E-Resources:** 1. Programming in C++ https://nptel.ac.in/courses/106105151/ 2. Computer Organizations and Architecture https://nptel.ac.in/courses/106103068/ 3. Stallings, W. (2003). *Computer organization and architecture: designing for performance*. Pearson Education India. http://williamstallings.com/ComputerOrganization/	

2	CS 103L Computer Architecture and Object Oriented Programming Lab	On successful completion of the course students will be able to • Apply object oriented approach to implement software solutions. • Use C++ to demonstrate practical experience in developing object-oriented solutions. • Develop analytical skills to write the programs based on classes and objects.	--	--	

Semester: III

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1	CS 210 Data Structures	After completion of this course students will be able to - • Choose appropriate data structure as applied to specified problem definition. • Handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures. • Use linear and non-linear data structures like stacks, queues , linked list etc. • Understand Internal representation of Linear and nonlinear data structures.	--	**Suggested Books:** 1. Aho, A., Hopcroft, J., & Ullman, J. (1974). *The Design and Analysis of Algorithms*.Addison and Wesley. *Reading, MA*. 2. Tremblay, J. P., & Sorenson, P. G. (1976). *An introduction to data structures with applications. McGraw-Hill Computer Science Series, New York: McGraw-Hill, 1976*. 3. Knuth, D. E., & Knuth, D. E. (1973). *Fundamental algorithms*(Vol. 1). Reading, MA: Addison-Wesley. 4. Horowitz, E. (2006). *Fundamentals of data structures in C++*.Galgotia Publications. 5. Tenenbaum, A. M. (1990). *Data structures using C*. Pearson Education India. 6. Kruse, R., &Tondo, C. L. (2007). *Data structures*	

				and program design in C. Pearson Education India. 7. Lipschutz, S. (1987). *Schaum's Outline of Data Structure*. McGraw-Hill, Inc.. **Suggested E-Resources:** 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/	
2	CS 210L Data Structures Lab	After completion of this course students will be able to - • Implement the ADTs stack, queue, and deque using array and pointer. • Understand the performance of the implementations of basic linear data structures. • Understand prefix, infix, and postfix expression formats. • Recognize problem properties where stacks, queues, and deques are appropriate data structures.	--		

Semester: IV

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1	CS 208 Computer Oriented Numerical and Statistical Method	On successful completion of the course students will be able to • Apply numerical methods to obtain approximate solutions to mathematical problems. • Recognize the errors obtained in the numerical solution of problems. • Implement algorithms to solve selected problems. • Implement and compare different algorithms with respect to accuracy and efficiency of solution.	--	**Suggested Books**: 1. Rajaraman, V. *Computer Oriented Numerical Methods*. 2004. 2. Sastry, S. S. (2012). *Introductory methods of numerical analysis*. PHI Learning Pvt. Ltd.. 3. Gupta, S. P. (1994). *Statistical Methods*, Sultan Chand & Sons, New Delhi, pp. *E10*, 1-61. 4. Gupta, S. C., & Kapoor, V. K. (1997). *Fundamentals of Mathematical Statistics*, Ninth Extensively.Revised Edition, Sultan Chand & Sons. 5. Grewal, B. S. (2018). *Numerical Methods in Engineering and Science:(C, and C++, and MATLAB)*. Stylus Publishing, LLC. 6. Krishnamurthy, E. V., & Sen, S. K. *Numerical Algorithms: Computations in Science and Engineering. 2001*. *Affiliated East-West Press, New Delhi*. 7. Govil R., *Kamputer se sankhyatmakReetiyan*, et.al. Pitamber Publications, New Delhi 8. Krishnamurthy, E. V., & Sen, S. K. (1976). *Computer-based numerical algorithms*.East-West Press. 9. Rao, K. S. (2017). *Numerical methods for scientists and engineers*. PHI Learning Pvt. Ltd.. 10. Yule, G. U., & Kendall, M. G. (1987). *An Introduction to the Theory of Statistics* Universal Book Stall. *New Delhi*. 11. Agarwal, B. L. (2006). *Basic statistics*.New Age International.	

				Suggested E-Resources: 1. Numerical methods and programming https://nptel.ac.in/courses/122106033/	
2	CS 208L Computer Oriented Numerical and Statistical Method Lab	On successful completion of the course students will be able to • Implement numerical methods algorithms to solve mathematical problems. • Write programs solve given non-linear equations, systems of linear equations, interpolation, numerical differentiation and integration and numerical solution of ordinary differential equations. • Analyze the errors obtained in the numerical solution of problems. • Apply appropriate algorithms to solve selected problems, both manually and by writing computer programs.	--		

Semester: V

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1	CS 316 Business Data Processing and Database Management System	On successful completion of the course students will be able to • Develop Business applications in Cobol. • Identify all peripheral devices. • Prepare of all documents developed during system development. • Identifies key of various types, use SQL-the standard language of relational databases, normalize data base	--	**Suggested Books :** 1. Orilla, *An Introduction to Business Data Processing*, Tata Mc Graw Hill 2. Roy, M. K., &Dastidar, D. G. (1989). *COBOL programming*.Tata McGraw-Hill Education. 3. Elmasri, R., &Navathe, S. (2010). *Fundamentals of database systems*. Addison-Wesley Publishing Company. 4. Bayross I, Structured Query Language, BPB 5. Martin, J. (1977). *Computer database organization*. Prentice Hall PTR *6.* Date, C. J. (1990*). An introduction to database systems. Volume 1* *7.* Silberschatz, A., Korth, H. F., &Sudarshan, S. (1997). Database system concepts (Vol. 4). New York: McGraw-Hill 8. Leon, A., & Leon, M. (2010). *Database management systems*.Vikas Publishing House Pvt. Limited **Suggested E-Resources:** 1. COBOL Programming http://www.csis.ul.ie/cobol/course/Default.htm 2. Norton, P. (2002). *Introduction to computers*. McGraw Hill. https://onlinestudy4u.files.wordpress.com/2012/10/introduction-to-computers-by-peter-norton-6th-ed.pdf 3. Data Base Management System https://nptel.ac.in/courses/106105175/ 4. Database Management Essentials https://www.coursera.org/learn/database-management	
2	CS 316L Business	On successful completion of the course	--		

	Data Processing and Database Management System Lab	students will be able to • Develop Business applications in COBOL. • Read and write files using COBOL programs. • Implement database and query optimization using COBOL. • Implement Concepts od DDL,DML and DCL.			

Semester: VI

S. N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1	Communication Systems	On successful completion of the course students will • Be able to demonstrate knowledge of the network and its application areas. • Have the ability to use various networks protocols. • Have an understanding of the proper contents of a data communication and networking.	--	-- **Suggested Books :** 1. Kennedy George "Electronics communication system", TMH, 4th edition, 1999 TMH, New Delhi. 2. Gulati R. R. "Monochrome &colour TV" , 1986, Wiley Eastern, New Delhi. 3. Shilling Taub , " Communication system" , TMH, 2nd Edition 4. Lathi BP, "Analog & Digital Communication", Oxford University Press 5. Sharma S.P. " Basic radio & TV, TMH", 1983, TMH, New Delhi. **Suggested E-Resources:** 1. Kurose, J. F., & Ross, K. W. (2009). *Computer networking: a top-down approach*. Boston: Addison Wesley. https://www.bau.edu.jo/UserPortal/UserProfile/PostsAttach/10617_1870_1.pdf 2. Data Communication https://nptel.ac.in/courses/106105082/	

Name of Programme: B.A.
(Courses in Computer Science)

Semester I

Existing Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 106	Computer Fundamentals	4	0	0	4
	Total				

Proposed Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Computer Fundamentals	4	0	0	4
	Total				

Semester II

Existing Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 110	Computer Programming	6	0	0	6
CS 110L	Computer Programming Lab	0	0	4	2
	Total				

Proposed Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Computer Programming	6	0	0	6
	Computer Programming Lab	0	0	4	2
	Total				

Semester III

Existing Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 210	Data Structures	6	0	0	6
CS210L	Data Structures Lab	0	0	4	2
	Total				

Proposed Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Data Structures	6	0	0	6
	Data Structures Lab	0	0	4	2
	Total				

Semester IV

Existing Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 201	Application Software and Visual Computing	6	0	0	6
CS 201L	Application Software and Visual Computing Lab	0	0	4	2
	Total				

Proposed Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Application Software and Visual Computing	6	0	0	6
	Application Software and Visual Computing Lab	0	0	4	2
	Total				

Semester V

Existing Scheme

Proposed Scheme

Course Code	Course Name	L	T	P	C
5.1	Database Management Systems	6	0	0	6
5.2	Database Management Systems Lab	0	0	4	2
	Total				

Course Code	Course Name	L	T	P	C
To be filled by the office	Discipline Elective – I	6	0	0	6
	Discipline Elective – I Lab	0	0	4	2
	Total				

Semester VI

Existing Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
6.1	Multimedia and Web Designing	6	0	0	6
6.2	Multimedia and Web Designing Lab	0	0	4	2
	Total				

Proposed Scheme					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Discipline Elective – II	6	0	0	6
	Discipline Elective – II Lab	0	0	4	2
	Total				

Discipline Electives

Course Code	Course Name	L	T	P	C
To be filled by the office	Database Management System	6	0	0	6
	Programming in Java	6	0	0	6
	Multimedia and Web Designing	6	0	0	6
	Web Development and .NET Framework	6	0	0	6

Discipline Electives Lab

Course Code	Course Name	L	T	P	
To be filled by the office	Database Management System Lab	0	0	4	2
	Programming in Java Lab	0	0	4	2
	Multimedia and Web Designing Lab	0	0	4	2
	Web Development and .NET Framework Lab	0	0	4	2

Name of Programme: MCA

Course Details:

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Semester I		
1	**CS 207** Computer Organization and Architecture	On successful completion of the course students will be able to • Perform computer arithmetic operations. • Use the concepts and design of all type of sequential and combinational circuits. • Design and conduct experiments, as well as to analyze of the hardware of a computer system and its components. • Design techniques such as pipelining and microprogramming in the design of the central processing unit of a computer system. • Understand the concept of I/O organization.	**Section-A** Brief introduction to computer organization, 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 character: BCD, ASCII, EBCDIC Codes, Self Complementary Codes, Error Detecting Codes and Error correcting codes (Parity, Gray & Hamming Codes). Logic Gates and Boolean Algebra, Karnaugh Map, Combinational Circuit Design: Adder, Subtractor, Decoder, Demultiplexer, Encoder, Multiplexer, Comparator. **Section-B** Basics of logic families, Sequential Circuits, Flip-Flop, Shift Register, Asynchronous and Synchronous Counters. Semiconductor Memories: Types of Memories, Sequential and Random Access Memory (RAM, ROM, PROM, EPROM) Storage location and address, fixed and variable word length storage, Cache Memory, bubble memory, Secondary Memory devices and their characteristics. **Section-C** Data bus and address bus, stack organization, various registers, instruction formats, various addressing techniques. I/O Organization-Simple I/O devices and their properties, device interfacing, DMA interface, program & interrupt control transfer. CPU Organization: Design of ALU, Magnitude comparator, design of shifter and accumulator, Status Register, Processor unit, Control unit organization, Hardware and Micro-porgrammed control, Firmware, Control of Processor unit,		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Microprogram sequencer. **Suggested Books:** 1. Mano, M. M. (2007). *Computer System Architecture* (3rd ed.). Pearson Education. 2. Mano, M. M. (2017). *Digital Logic and Computer Design*. Pearson Education. 3. Leach, D. P., Malvino, A.P., & Saha G.*Digital Principles and Applications*(6th ed.). Tata Mc-Graw Hill. 4. Malvino & Brown.*Digital Computer Electronics*(3rd ed.).Tata McGraw Hill. 5. Floyd and Jain. *Digital Fundamentals (8th ed.).* Pearson Education. 6. W. Stallings.*Computer Organization and Architecture* (7th ed.). Pearson Education.	**Suggested Books:** 1. Mano, M. M. (2007). *Computer System Architecture* (3rd ed.). Pearson Education. 2. Mano, M. M. (2017). *Digital Logic and Computer Design*. Pearson Education. 3. Leach, D. P., Malvino, A.P., & Saha G.*Digital Principles and Applications*(6th ed.). Tata Mc-Graw Hill. 4. Malvino & Brown.*Digital Computer Electronics*(3rd ed.).Tata McGraw Hill. 5. Floyd and Jain. *Digital Fundamentals (8th ed.).* Pearson Education. 6. W. Stallings.*Computer Organization and Architecture* (7th ed.). Pearson Education. **Suggested E-Resources:** 1. Computer Organizations and Architecture 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/	
2	**CS 413** Computer Oriented Numerical and Statistical Methods	On successful completion of the course students will be able to • Apply numerical methods to obtain approximate solutions to mathematical problems. • Use appropriate numerical methods, determine the solutions to given non-linear	**Section-A** Errors and Approximations in Digital Computers, Number representation, Floating point Arithmetic. Solution of systems of linear equations - direct method, Gauss Jordan & Gauss Elimination methods, Pivoting, Iterative methods - Jacobi & Gauss Seidel method. Solution of Nonlinear equations in n variable : Localization of the roots, Bisection and Regula-Falsi methods, Newton-Raphson method, Secant method successive Approximation method, Rate of convergence and Aitkin's process. **Section-B**		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		equations and systems of linear equations. • Analyze the errors obtained in the numerical solution of problems. • Compare different algorithms with respect to accuracy and efficiency of solution. • Implement numerical methods algorithm using programming language.	Interpolation: Newton's Interpolation formulae - Forward and Backward difference formulae, Lagrange's and Divided difference Interpolation formula, Error term and error of Interpolation, Inverse Interpolation. Numerical Differentiation and Integration: Differentiation formula based on Interpolating polynomials- Newton-Gregory Forward, Backward and Divided difference Polynomial, Newton-Cotes formulae - Trapezoidal & Simpson's rule, change of interval of integration. Numerical solution of ordinary Differential equations : ODE's as a system of first order ODE's, Euler's, Picard's and Taylor series methods of real functions, Runge-Kutta 2nd order method, Runge-kutta 4th order method. Modified Euler's Method, Predictor-corrector method. Polynomial Approximations, Least squares approximation. **Section-C** Statistical methods: treatment of data, frequency distribution, measures of central tendency, dispersion and partition values .Probability distribution-Binomial, Poisson and Normal. Correlation and regression. Inference- test of significance for large sample only (mean, variance, proportion),chi-square test for goodness of fit and Independence of attributes. Analysis of variance, analysis of covariance. **Suggested Books:** 1. Rajaraman, V. (1993).*Computer Oriented Numerical Methods* (3rd ed.). PHI Learning, New Delhi. 2. Cheney E.W. & Kincaid D.R. (2008).*Numerical Methods and Applications*. Cengage Learning, New Delhi. 3. Gupta, S.P. (2008).*Statistical Method*s (11th ed.). Sultan Chand &Sons, New Delhi. 4. Gupta, S.C.& Kapoor, V. K. (2002). *Fundamentals of Mathematical Statistics*(11th ed.). Sultan Chand &Sons, New Delhi. 5. Krishnamurthy, E.V. & Kumar S.S. (1976). *Computer Based Numerical Algorithms*. East West Press, New Delhi. 6. Rao, K.S. (2007).*Numerical Method for Scientists and*	**Suggested Books:** 1. Rajaraman, V. (1993).*Computer Oriented Numerical Methods* (3rd ed.). PHI Learning, New Delhi. 2. Cheney E.W. & Kincaid D.R. (2008).*Numerical Methods and Applications*. Cengage Learning, New Delhi. 3. Gupta, S.P. (2008).*Statistical Method*s (11th ed.). Sultan Chand &Sons, New Delhi. 4. Gupta, S.C.& Kapoor, V. K. (2002). *Fundamentals of Mathematical Statistics*(11th ed.). Sultan Chand &Sons, New Delhi. 5. Krishnamurthy, E.V. & Kumar S.S. (1976). *Computer Based Numerical Algorithms*. East West Press, New Delhi. 6. Rao, K.S. (2007).*Numerical Method for Scientists and*	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Engineers. PHI Learning Pvt. Ltd., New Delhi. 7. Sastry, S.S. (2008).*Introductory Methods of Numeric Analysis*(4th ed.).PHI Learning Pvt. Ltd., New Delhi. 8. Yule, G.U. & Kendall, M.G. *An Introduction to the Theory of Statistics*, Universal Book Stall. 9. Agarwal, B.L.*Basic Statistics.* New Age International Publication.	*Engineers.* PHI Learning Pvt. Ltd., New Delhi. 7. Sastry, S.S. (2008).*Introductory Methods of Numeric Analysis*(4th ed.).PHI Learning Pvt. Ltd., New Delhi. 8. Yule, G.U. & Kendall, M.G. *An Introduction to the Theory of Statistics*, Universal Book Stall. 9. Agarwal, B.L.*Basic Statistics.* New Age International Publication. **Suggested E-Resources:** 1. Computer Oriented Numerical and Statistical Methods https://nptel.ac.in/courses/122106033/# 2. Computer Oriented Numerical and Statistical Methods https://www.mooc-list.com/tags/numerical-methods	
3	**CS 415** Computer Programming	On successful completion of the course students will be able to • Understand the concepts of computer basics and programming. • Understand the organization and operations of a computer system. • Understand binary logic in design of electronic circuits. • Have logical thinking for Analyzing problems, designing and implementing algorithmic solutions. • Acquire the skills for the use of the C programming language to implement the real world applications.	**Section-A** **Fundamentals of Computer System:** Block Diagram, CPU, Memory, Input/Output Devices. Hardware and Software, Booting Process and DOS Commands. **Steps in Program Development:** Problem analysis, algorithms & flow charts, High level and low level programming languages. **Computer Programming Using C:** History, Data types (simple and structured) and their representation, Constants and variables, Operators, Arithmetic's and logical expressions, Type casting, Input and output statements. **Section-B** **Control Statements:** Sequencing, Conditional and unconditional branching and looping. **Arrays:** Single and multidimensional arrays, Arrays and strings, String built-in functions, Applications of arrays: Searching (linear and binary), Sorting (bubble, selection and insertion). Structured Programming: Function declaration and definition, Function call, Passing parameters to the functions: call by value, call by reference. Returning values, Recursive functions, Passing arrays to functions.		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Section-C **Storage classes in C:** Automatic, Register, External, and Static. **Pointers:**Pointer arithmetic, Pointers and arrays, Pointers and strings, Pointer to pointer, Dynamic Memory Allocation. **Derived Data Types:** Structures, unions, Array of structure, Pointer to structure, enumerated data types. **File Handling in C:** Types of files,Opening and closing a data file, reading and writing a data file, Random access in a file, Error handling during file I/O operations, Command line arguments. **Suggested Books:** 1. Kanetkar, Y. P. (2009).*Let us C*. BPB Publications. 2. Sinha,P. K. (2004).*Computer Fundamentals: Concept, Systems and Applications*. BPB Publications. 3. Kernighan, B. W., & Ritchie, D. M. (2006). *The C Programming Language*. PHI Learning Pvt. Ltd., New Delhi. 4. Kanetkar, Y. P. (2009). *Understanding Pointers in C*. BPB Publications. 5. Dromey, R. G. (2007).*How to Solve it by Computer*.PHI Learning Pvt. Ltd . New Delhi. 6. Govil, Mahesh Chand, *Computer Fundamentals and Programming in C*, Jaipur Publishing House. 7. NIIT, *Introduction to Computer Programming*(2005).PHI Learning Pvt. Ltd . New Delhi. 8. Venugopal, K. R. (2005). *Programming with C*. Tata McGraw-Hill. 9. Balagurusamy, E., (2010). *Programming in ANSI C*. Tata McGraw-Hill.	**Suggested Books:** 1. Kanetkar, Y. P. (2009).*Let us C*. BPB Publications. 2. Sinha,P. K. (2004).*Computer Fundamentals: Concept, Systems and Applications*. BPB Publications. 3. Kernighan, B. W., & Ritchie, D. M. (2006). *The C Programming Language*. PHI Learning Pvt. Ltd., New Delhi. 4. Kanetkar, Y. P. (2009). *Understanding Pointers in C*. BPB Publications. 5. Dromey, R. G. (2007).*How to Solve it by Computer*.PHI Learning Pvt. Ltd . New Delhi. 6. Govil, Mahesh Chand, *Computer Fundamentals and Programming in C*, Jaipur Publishing House. 7. NIIT, *Introduction to Computer Programming*(2005).PHI Learning Pvt. Ltd . New Delhi. 8. Venugopal, K. R. (2005). *Programming with C*. Tata McGraw-Hill. 9. Balagurusamy, E., (2010). *Programming in ANSI C*. Tata McGraw-Hill. **Suggested E-Resources:** 1. Introduction to Programming in C https://nptel.ac.in/courses/106104128/ 2. Introduction to Programming in C Specialization	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
				https://www.coursera.org/specializations/c-programming 3. Computer Fundamentals https://www.edutechlearners.com/computer-fundamentals-p-k-sinha-free-pdf/	
4	**CS 434** System Programming	On successful completion of the course students will be able to • Understand the basics of system programs like editors, compiler, assembler, linker, loader, interpreter and debugger. • Describe the various concepts of assemblers and macro-processors. • Understand the various phases of compiler and compare its working with assembler. • Understand how linker and loader create an executable program from an object module created by assembler and compiler. • Know various editors and debugging techniques.	**Section-A** System Software: Components and Evolution. General Machine Structure: Memory, Instructions, Registers. Operating Systems: Types & basic functions. 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). **Section-C** Software Tools: Editors, Debug Monitors, Program generators Translators: Interpreters, Compiler: Brief description of different phases. ROM BIOS, EMS, input and output services. Device Drives: Types, structure and processing. Interrupt: Types, Organization, processing, IVT, interrupt handler. **Suggested Books:** 1. Donovan J.J (1991). *Systems Programming*. Tata Mc-Graw Hill. 2. Dunkan R (1994).*Advance MS-DOS Programming*, BPB Publications. 3. Elzeey Roy S. (1987).*Computer System Software*, Science Research Associates. 4. Dhamdhere D.M. (1987). *Introduction to System Software*.	**Suggested Books:** 1. Donovan J.J (1991). *Systems Programming*. Tata Mc-Graw Hill. 2. Dunkan R (1994).*Advance MS-DOS Programming*, BPB Publications. 3. Elzeey Roy S. (1987).*Computer System Software*, Science Research Associates. 4. Dhamdhere D.M. (1987). *Introduction to System Software*.	No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Tata Mc-Graw Hill. 5. Bigger Staff T. J.(1986). *System Software Tools*, PHI Learning Pvt. Ltd . New Delhi. 6. Dhamdhere D.M (2001).*System Programming and Operating Systems*(2nd ed.). Tata Mc-Graw Hill. 7. Bose S.K. (1991). *Hardware and Software of Personal Computers*. New Age International Publishers.	Tata Mc-Graw Hill. 5. Bigger Staff T. J.(1986). *System Software Tools*, PHI Learning Pvt. Ltd . New Delhi. 6. Dhamdhere D.M (2001).*System Programming and Operating Systems*(2nd ed.). Tata Mc-Graw Hill. 7. Bose S.K. (1991). *Hardware and Software of Personal Computers*. New Age International Publishers. **Suggested E-Resources:** 1. System Programming http://solomon.ipv6.club.tw/Course/SP.941/	
5	**CS 437** Web Technology	On successful completion of the course students will be able to • Understand working of Internet & World Wide Web. • Develop a dynamic webpage by the use of java script, HTML & CSS. • Develop an application using Javascript. • Develop web application using PHP with database connectivity. • Get the knowledge of publishing and hosting web application.	**Section-A** **Internet:** Concept of Networking, Applications, Evolution of Internet, Basic Internet services, WWW, Concept of Web browser, Web server, Domain Name Server (DNS), URL, HTTP, Internet Service Providers, Search engines, Cookies, Basics of Web site design, Characteristics of a good website, Web hosting and Web publishing, Web crawlers, Introduction to Web Design Tools (Front page, Dreamweaver). **HTML:** Introduction, Elements, Structure of HTML code, Attributes, Headings, Paragraphs, Styles, Formatting, Lists, Quotations, Links, Images, Tables, Forms, Frame, DHTML. **Section-B** **Cascading Style Sheets (CSS):** Syntax, Internal, External and Embedded CSS. CSS: Text, Fonts, Links, Tables, Border, Outline, Margin, Class Selector, ID Selector. **JavaScript:** Introduction, Syntax, Data types, Variables, Expressions, Operators, Conditional statements, Looping structures: while, do while, for. Arrays, Functions, Forms and validations, Event Handling, DOM of JavaScript, JavaScript objects. **Section-C** **PHP Introduction:** Origin, PHP with the Web Server, syntax,		

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			data types, variables, constant, expression, operator, Control structure, Loops, Functions, argument passing in functions, References, Pass by Value & Pass by references, Return Values, Variable Scope, Array, Form handling, String handling, Cookies and Sessions, Basics of MySql, Connectivity with MySql. **Suggested Books:** 1. Deborah S. Roy &Eric J. Roy.*Mastering HTML 4.0*. BPB Publications. 2. Bayross I. (2009).*Web Enabled Commercial Applications Development Using HTML, DHTML and PHP* (4th ed.). BPB Publications. 3. Holzner, S. (2008). *PHP: The Complete Reference*. Tata McGraw-Hill. 4. P.J. Deitel,& H.M. Deitel.*Internet and World Wide Web How to Program*, Pearson Education. 5. Greenlaw, R., & Hepp, E. (2001). *Fundamentals of the Internet and the World Wide Web*(2nd ed.*)*. Tata McGraw-Hill.	**Suggested Books:** 1. Deborah S. Roy &Eric J. Roy.*Mastering HTML 4.0*. BPB Publications. 2. Bayross I. (2009).*Web Enabled Commercial Applications Development Using HTML, DHTML and PHP* (4th ed.). BPB Publications. 3. Holzner, S. (2008). *PHP: The Complete Reference*. Tata McGraw-Hill. 4. P.J. Deitel,& H.M. Deitel.*Internet and World Wide Web How to Program*, Pearson Education. 5. Greenlaw, R., & Hepp, E. (2001). *Fundamentals of the Internet and the World Wide Web*(2nd ed.*)*. Tata McGraw-Hill. **Suggested E-Resources:** 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/	
6	CS 413L Computer Oriented Numerical and Statistical Methods Lab	On successful completion of the course students will be able to • Implement approximate solutions to mathematical	**Lab No.** **Problems** L01 Perform floating point operations using normalization (addition, subtraction, multiplication, division) L02-L03 Find the roots of equation (bisection method, regula-falsi method, Newton raphson method, secant		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		problems. • Implement solutions to given non-linear equations and systems of linear equations. • Compare different algorithms by implementing them with respect to accuracy and efficiency of the solution.	method, successive approximation method) L04-L05 Find solution of n linear equation (Gauss elimination method (with & without pivoting). Gauss Seidel method. Gauss Jordan method L06 Generate following difference tables (forward, backward, divided difference) L07-L09 Interpolate value of f(x) at given x (Lagrange's interpolation method, Newton forward interpolation method, Newton's backward interpolation method), Inverse interpolation L10-L11 Fitting of different curves (straight line fit (x on y), straight line fit (y on x), parabola, geometric curve, exponential curve) L12- L13 Find derivative of a given tabulated function at given value (Newton's forward method, Newton's backward method) L14 – L16 Find Integrated value, (when tabulated function given-Trapezoidal rule (simple & modified), Simpson's 1/3 (simple & modified), Simpson's 3/8 (simple & modified) L17 – L19 Find Integrated value, when algebraic expression given (when algebraic expression given-Trapezoidal rule (simple & modified), Simpson's 1/3 (simple & modified), Simpson's 3/8 (simple & modified). L20-L21 Solve differential equation (Euler's method, Runge-Kutta 2nd order method, Runge-kutta 4th order method. Modified Euler's method, Predictor-corrector method. L22-L23 Determination of Mean, Median, Mode, G.M., H.M., Quartiles, Deciles and Percentiles. L24-L25 Computation of Range, Standard deviation, Mean deviation, Quartile deviation and Coefficient of variation. L26 Computation of coefficients of correlation and rank correlation.		

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			L27-L28 Fitting of (i) Binomial, (ii) Poisson L29 Test of Significance problems for Large sample testing L30-L31 Chi Square test for goodness of fit and independence of attributes L32 ANOVA for one way classification.		
7	**CS 415L** Computer Programming Lab	On 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 Number Problems** L1-L3 Simple hands on computers and DOS Internal & External Commands L4-L6 Simple Problems Using scanf and printf functions. Formula Based Problems using Constants, Variables and use of operators. L7-L8 Use of Library Functions e.g. sqrt, sin, cos, log etc. L9-L20 Loop Statement using for, while, do –while statement L21-L25 Conditional Checking Using if statement, Nested if statement, switch statement and Unconditional goto L26-L40 Problems based on array data types. Problems on One Dimensional Array-Searching (Linear, Binary), Sorting (Bubble, Selection, Insertion), Merging. L41-L45 Problems on two Dimensional Array -Matrix Operation: Addition, Subtraction, Multiplication etc. L46-L50 Problems based on pointers, Parameter passing in functions, Recursion L51-L55 Declaration, Reading, Writing and manipulation on struct and union data type L56-L62 File handling L63-L64 Command line Arguments		No change
8	**CS 437L** Web Technology Lab	On successful completion of the course students will be able to • Design web pages containing tables, images and links using	**Lab Number Problems** L1-L2 Create a page with HTML basic tag like, Paragraph, formatting, inserting image L3 Create different types of list using HTML L4 Create pages with internal and external linking using		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		HTML and CSS. • Design web pages using DIV, Class and ID selector. • Design dynamic web pages using Java Script and PHP.	HTML L5-L6 Create different types of tables using HTML L7 Create different types of image maps using HTML L8-L9 Create pages with different frame formats using HTML L10-L11 Create pages using HTML form, CSS Introduction L12- L14 Types of CSS Designing a web page using Font Tables and Link in CSS and HTML L15 Create a pages using DIV L16 Create a pages using Class and ID Selector L17-18 Java Script Introduction, Use of data types, variables, constant, Expression, operator in Java Script L19-L21 Use of conditional statements in Java Script L22-L24 Use of looping statements in Java Script L25-26 Java Script functions L 27- L28 Java Script DOM and Event in Java Script L29-L30 PHP Introduction, Use of data types, variables, constant, Expression, operator L31 Use of conditional statements in PHP L32-L33 Use of looping statements in PHP L34-L35 Creating different types of arrays L36-37 Usage of array functions L38-39 Creating user defined functions, Functions Call by value and call by reference L40 Form handling using GET, POST L41 Creation of sessions, Cookies L 42 Creating web page using QueryString and Hidden Field L43- L45 Database Connectivity, ADD, DELETE, UPDATE and VIEW data from database		

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Semester II		
9	**CS 209** Data Structures	On 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. • 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. • Learn to analyze and compare algorithms for efficiency using Big-O notation. • Understand 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). **Suggested Books:** 1. Langsam, Y., Augenstein, M., & Tenenbaum, A. M. *Data Structures using C and C++*. PHI Learning, New Delhi. 2. Tremblay, J. P., & Sorenson, P. G. (1985). *An Introduction to Data Structures with Applications*. Tata McGraw-Hill. 2. Horowitz E. & S. Sahni(2009).*Fundamentals of Data Structures*. University Press. 3. A.V. Aho, J.E. Hopecraft & J.D. Ullman(1987).*Data*	**Suggested Books:** 1. Langsam, Y., Augenstein, M., & Tenenbaum, A. M. *Data Structures using C and C++*. PHI Learning, New Delhi. 2. Tremblay, J. P., & Sorenson, P. G. (1985). *An Introduction to Data Structures with Applications*. Tata McGraw-Hill. 2. Horowitz E. & S. Sahni(2009).*Fundamentals of Data Structures*. University Press. 3. A.V. Aho, J.E. Hopecraft & J.D. Ullman(1987).*Data*	No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Structures and Algorithms. Addition –Wesley Publishing Co. 4. Lipschutz, Seymour. *Schaum's Outline of Theory and Problems of Data Structures*.Tata McGraw-Hill.	*Structures and Algorithms*. Addition –Wesley Publishing Co. 4. Lipschutz, Seymour. *Schaum's Outline of Theory and Problems of Data Structures*.Tata McGraw-Hill. **Suggested E-Resources:** 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/	
10	**CS 417** Database Management Systems	On successful completion of the course students will be able to • Describe data models and schemas in DBMS • Understand the features of database management system and Relational databases. • Use SQL -the standard language of relational databases. • Understand the functional dependencies and design of the database. • Understand the concept of Transaction and Query processing.	**Section-A** Introduction: Database system concepts and architecture, Data models schema and instances, Data independence and database language and interface, Data definition languages, DML, Overall database structure. Data modeling using Entity Relationship Model: E. R. model concepts, notation for ER diagrams, mapping constraints, Keys, Concept of super key, candidate key, primary key, Generalization, Aggregation, reducing ER diagrams to tables, extended ER model, Relationship of higher degree. Relational Data Model and Language: Relational data model concepts, relational algebra, relational calculus, tuple and domain calculus, SQL, data definition queries and updates in SQL, integrity constraints, Keys-constraints, domain constraints, referential integrity, assertions, security of databases. **Section-B** Example DBMS System (Oracle 8): Basic architecture, data definition and data manipulation, ISQL, PLSQL, cursors, triggers, stored procedures. Database design : Functional dependencies, normal forms, first, second and third functional personal normal forms. BCNF, multivalued dependencies, fourth normal forms, join dependencies and fifth normal forms. Steps in database design. Query processing: Steps of Query Processing, Measures of Query Cost, Selection Operation, Sorting, Join Operation, Evaluation of Expressions.		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Section-C Query Optimization: Catalog Information for Cost Estimation, Estimation of Statistics, Transformation of Relational Expressions, Dynamic Programming for Choosing Evaluation Plans. Transaction processing concepts. Concurrency control techniques, locking techniques, and time stamping and concurrency control. Recovery-Log-Based, Shadow Paging, Recovery with concurrent Transactions Distributed database systems: Fragments of Relations, Optimization transmission cost by semi joins, Distributed concurrency control, Management of deadlocks. **Suggested Books:** 1. Korth Henry F., Silberschatz Abraham, &Sudarshan S. (2006). *Database System Concepts*(5th ed.). Tata McGraw-Hill. 2. Murdick, R. G., Ross, J. E., & Claggett, J. R. *Information Systems for Modern Management*. Prentice Hall Professional Technical Reference. 3. Date C.J. *An Introduction to Database Systems*. Addison Wesley. 4. Majumdar & Bhattachrya.*Database Management System*. Tata McGraw-Hill. 5. Ramakrishnan, R., & Gehrke, J. (2000). *Database Management Systems*. Tata McGraw-Hill. 6. Leon, A., & Leon, M. (2010). *Database Management Systems*. Vikas Publishing House Pvt. Limited.	**Suggested Books:** 1. Korth Henry F., Silberschatz Abraham, &Sudarshan S. (2006). *Database System Concepts*(5th ed.). Tata McGraw-Hill. 2. Murdick, R. G., Ross, J. E., & Claggett, J. R. *Information Systems for Modern Management*. Prentice Hall Professional Technical Reference. 3. Date C.J. *An Introduction to Database Systems.* Addison Wesley. 4. Majumdar & Bhattachrya.*Database Management System*. Tata McGraw-Hill. 5. Ramakrishnan, R., & Gehrke, J. (2000). *Database Management Systems*. Tata McGraw-Hill. 6. Leon, A., & Leon, M. (2010). *Database Management Systems*. Vikas Publishing House Pvt. Limited. **Suggested E-Resources:** 1. Data Base Management System https://nptel.ac.in/courses/106105175/ 2. Database Management Essentials by University of Colorado https://www.coursera.org/learn/database-management	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
				3. Database System Concepts by Abraham Silberschatz, Henry F. Korth and S. Sudarshan https://kakeboksen.td.org.uit.no/Database%20System%20Concepts%206th%20edition.pdf	
11	**CS 425** Object Oriented Methodology and Programming	On successful completion of the course students will be able to • Understand the features of C++ supporting object oriented programming • Understand how to produce object-oriented software using C++ • Understand how to apply the major object-oriented concepts to implement object oriented programs in C++, encapsulation, inheritance and polymorphism • Understand advanced features of C++ specifically stream I/O, templates and operator overloading • Understand other features of the C++ language including templates, forms of casting, conversions, and file handling.	**Section-A** **Object-Oriented Methodology:** Differences from Functional Methodology, Abstraction, Encapsulation, Object Modeling Technique, Objects, Classes, Object Diagrams, Attributes, Operations and Methods, Links, Associations, Multiplicity, Generalization and Inheritance, Aggregation, Abstract Classes, Multiple Inheritance **C++:** Tokens, Data Types, Operators and Expressions, Promotion and Type Conversion, Operator Precedence and Associativity, Conditional and Looping Constructs, Operations on Arrays, Strings Manipulations, Function Components, Parameter Passing, Return by Reference, Default Arguments, Inline Functions, Function Overloading, Arrays and Functions, Scope and Extent of Variables, Storage Classes, Functions with Variable Number of Arguments, Recursive Functions, Class Specification, Class Objects, Data Hiding, Empty Classes, Passing Objects as Arguments, Returning Objects from Functions. **Section-B** Friend Functions and Friend Classes, Constant Parameters and Member Functions, Static Data and Member Functions, Constructors, Destructor, Constructor Overloading, Constructors with Default Arguments, Nameless Objects, Dynamic Initialization through Constructors, Copy Constructor, Constant Objects and Constructor, Static Data Members with Constructors and Destructors, Pointers and their Binding, void Pointers, Runtime Memory Management, Pointer Constants, Pointers to Constant Objects, Constant Pointer, Pointers to Objects, Live Objects, Array of Objects, this Pointer, Unary Operator Overloading, Increment/ Decrement Operators, Binary Operator Overloading, Arithmetic Operators, Concatenation of Strings, Comparison Operators, Arithmetic Assignment Operators, Overloading of new and delete Operators, Data Conversion, Overloading with Friend Functions, Assignment		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Operator Overloading, Inheritance and Member Accessibility, Constructors and Destructors in Derived Classes, Constructors Invocation and Data Member Initialization, Overloaded Member Functions, Abstract Classes, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Multipath Inheritance and Virtual Base Classes, Hybrid Inheritance. **Section-C** Virtual Functions, Pointer to Derived Class Objects, Pure Virtual Functions, Abstract Classes, Dynamic Binding Implementation, Function Templates, Overloaded Function Templates, Nesting of Function Calls, Multiple Arguments Function Template, User Defined Template Arguments, Class Templates, Inheritance of Class Template, Class Template Containership, Class Template with Overloaded Operators, Console I/O, Concept of Streams, Hierarchy of Console Stream Classes, Unformatted and Formatted I/O Operation, Managing Output with Manipulators, File Handling, Classes for File Stream Operation, Open and Close a File, File Models, File Pointers and their Manipulations, Sequential I/O Operations, Updating a File, Error Handling during File Operation, Exception Handling, Use of Standard Template Library (STL). **Suggested Books:** 1. Rumbaugh, J., Blaha, M., Premerlani, W., Eddy, F., & Lorensen, W. E. (1991). *Object-oriented Modeling and Design*. PHI Learning, New Delhi. 2. Venugopal, K.R., Buyya, Rajkumar, &Ravishankar (1997).*Mastering C++*. Tata Mc-Graw Hill. 3. Schildt, H. (2001). *C++: The Complete Reference*. Tata McGraw-Hill. 4. Balagurusamy, E. (2008). *Object Oriented Programming with C++*(6th ed.). Tata McGraw-Hill. 5. Kanetkar, Y. P. (2010). *Let us C++*. BPB Publications.	**Suggested Books:** 1. Rumbaugh, J., Blaha, M., Premerlani, W., Eddy, F., & Lorensen, W. E. (1991). *Object-oriented Modeling and Design*. PHI Learning, New Delhi. 2. Venugopal, K.R., Buyya, Rajkumar, &Ravishankar (1997).*Mastering C++*. Tata Mc-Graw Hill. 3. Schildt, H. (2001). *C++: The Complete Reference*. Tata McGraw-Hill. 4. Balagurusamy, E. (2008). *Object Oriented Programming with C++*(6th ed.). Tata McGraw-Hill. 5. Kanetkar, Y. P. (2010). *Let us C++*. BPB Publications. **Suggested E-Resources:**	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
				1. The C++ Programming Language http://www.stroustrup.com/C++.html 2. Programming in C++ https://nptel.ac.in/courses/106105151/	
12	**MATH 302** Introduction to Discrete Mathematics	On successful completion of the course students will be able to • Solve counting problems, sets, and Venn diagrams. • Apply the inclusion-exclusion principle to problems with more than two sets. • Understand the basics of discrete probability and be able to apply the methods from these subjects in problem solving • Understand the basic principles of lattices, Boolean algebra, numeric function, generating function, Pigeonhole Principle and problems based on graph • Solve linear homogeneous and linear non-homogeneous recurrence relations with constant coefficients using various methods	**Section-A** Permutations, Combinations, selection with & without replacement; Sets and multisets, permutation and combinations of multisets, enumeration of permutations and combination of sets & multisets, placing distinguishable (indistiguishable) objects into distinguishable (indistinguishable) boxes. Inclusion - Exclusion principle, Discrete probability; The rules of sum & product, generation of permutation and combinations. Relations and functions - properties of binary relations, equivalence relations, partial order relations, chains and antichains, Pigeon hole Principle. **Section-B** Basic cancepts of graph theory: vertices, edges, degree, paths, circuits, cycles, complete graphs and trees. Multi-graphs, weighted graphs and directed graphs. Adjacency matrix of a graphs. Connected and disconnected graphs. K-connected and K-edge connected graphs. Shortest path in weighted graphs, Eulerian path and circuits, Hamiltonian path and circuits. Planar graphs, chromatic number, edge colouring of graphs, Vizing's theorem. Trees and cut sets : Trees, spanning tree and cut set, minimum & panning tree. **Section-C** Lattices and boolean algebra; Algebraic structures : binary operation, group, ring, field; Mathematical Logic: Basic connectives, rules of inference, normal forms, proofs of validity, predicate logic. Generating functions and Recurrence relations Linear recurrence relation with constant coefficients and their solution, Homogeneous solution, particular solution & total solutions. Solution by the method of generating functions. **Suggested Books:** 1. Liu, C. L. (1987). *Elements of Discrete Mathematics*. Tata McGraw-Hill Education. 2. Kolman, B., Busby, R. C., & Ross, S. C. (2009). *Discrete*	**Suggested Books:** 1. Liu, C. L. (1987). *Elements of Discrete Mathematics*. Tata McGraw-Hill Education. 2. Kolman, B., Busby, R. C., & Ross, S. C. (2009). *Discrete*	No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Mathematical Structures. PHI Learning. 3. Deo N.(1974). *Graph Theory*, PHI Learning. 4. Trembley J. P. & Manohar R. (1975).*Discrete Mathematical Structures with Applications to Computer Science*. Tata McGraw Hill.	*Mathematical Structures*. PHI Learning. 3. Deo N.(1974). *Graph Theory*, PHI Learning. 4. Trembley J.P. & Manohar R. (1975).*Discrete Mathematical Structures with Applications to Computer Science*. Tata McGraw Hill. **Suggested E-Resources:** 1. Discrete Mathematics and Its Applications https://mathcs.clarku.edu/~djoyce/ma114/Rosen6E.pdf 2. Discrete Mathematical Structures https://nptel.ac.in/courses/106106094/	
13	**MGMT 421** Management Information System	On successful completion of the course students will be able to • Understand the leadership role of Management Information Systems in achieving business competitive advantage through informed decision making. • Effectively communicate strategic alternatives to facilitate decision making. • Record the current issues of information technology and relate those issues to the firm • Reproduce a working knowledge of concepts and terminology related to information technology	**Section-A** Introduction to management, Evolution of management, (Scientific Management – F.W. Taylor, Administration Management – Henry Fayol, Human Relation – Elton Mayo, System Approach) Functions of management, Overview of contemporary challenges : Global management, Workforce diversity, Corporate, Social responsibility. **Section-B** International Management Information System: Definition and Characteristics, Components of MIS, Framework of understanding MIS: Robert Anthony's, Hierarchy of Management Activity. Information requirements and Levels of Management. The new strategic role of Information systems, methodologies for evaluating investments in IT, Framework and methodologies should be discussed and illustrated with Case Studies, Critical success factor in implementing IT applications, Study of successful / failed IT projects. Critical role of security in implementing IT application. **Section-C** Decision Support System: Overview, components and classification, steps in constructing a DSS, role in business, group decision support system, integration and implementation of DSS, Information system for strategic advantage, strategic role for information system, reengineering business process,		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		• Interpret how to use information technology to solve business problems and illustrate the impact of information systems in society	improving business Qualities, Marketing Information system, Manufacturing IS, financial information system. **Suggested Books:** 1. Sadagopan, S. (2014). *Management Information Systems*(2nd ed.). PHI Learning, New Delhi. 2. Kroenke, D. M., & Boyle, R. J. (2016). *Using MIS*. PHI Learning, New Delhi 3. Miller, L. (2008). *MIS Cases: Decision Making with Application Software*(3rd ed.). PHl Learning, New Delhi. 5. Robbins, S. P., & Mary Coulter (2010).*MANAGEMENT*(10th ed.). PHI Learning, New Delhi 6. Weihrich, H., & Koontz, H. (2010). *Essentials of Management*(8th ed.). TataMcGraw-Hill.	**Suggested Books:** 1. Sadagopan, S. (2014). *Management Information Systems*(2nd ed.). PHI Learning, New Delhi. 2. Kroenke, D. M., & Boyle, R. J. (2016). *Using MIS*. PHI Learning, New Delhi 3. Miller, L. (2008). *MIS Cases: Decision Making with Application Software*(3rd ed.). PHl Learning, New Delhi. 5. Robbins, S. P., & Mary Coulter (2010).*MANAGEMENT*(10th ed.). PHI Learning, New Delhi 6. Weihrich, H., & Koontz, H. (2010). *Essentials of Management*(8th ed.). TataMcGraw-Hill.	
14	**CS 209L** Data Structures Lab	On 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-L10 Programs based on static implementation of stacks and its application L11-L18 Programs based on static implementation of queues (simple, circular, priority, dequeue) . L19-L30 Operations on Singly, Doubly & Circular Linked lists. Dynamic implementation of stacks and queues. L31-L40 Operations on Binary tree, binary search tree		No change
15	**CS 417L** Database Management Systems Lab	On successful completion of the course students will be able to • Create and manipulate structure of tables in	**Lab** **Problem** 1-5 Basic DDL commands(Create,Drop,Alter) with integrity constraints 6-10 DML & DCL commands (Insert, Update, Delete, Select, Commit, Rollback)		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		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.	11-13 Operators (Arithmatic,Logical,Relational etc.) 14-18 Assignment based on DDL and DML with conditions also Joins (Self join, inner join, outer join, equi join) 19-20 Complex queries (Retrieval of data from more than one table) 21-25 PL/SQL Block,Loops 26-27 Cursors, Triggers, Procedure, Function 28 Assignment of PL/SQL 29-32 Forms and report using front and tool. Connecting of database		
16	**CS 425L** Object Oriented Methodology and Programming Lab	On 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 based on** L1-L2 Operators and Expressions, Conditional and Looping Constructs, Operations on Arrays, Strings Manipulations L3-L4 Function Components, Default Arguments, Inline Functions, Function Overloading, Functions with Variable Number of Arguments, Recursive Functions L5-L7 Class Specification, Class Objects, Empty Classes, Passing Objects as Arguments, Returning Objects from Functions L8-L9 Friend Functions and Friend Classes L10 Static Data and Member Functions L11-L12 Constructors, Destructor, Nameless Objects, Copy Constructor, Static Data Members with Constructors and Destructors L13-L14 Pointers and their Binding, void Pointers, Pointers to Constant Objects, Constant Pointer, Pointers to Objects, Array of Objects, this Pointer L15-L17 Operator Overloading, Concatenation of Strings, Overloading of new and delete Operators, Data Conversion, Overloading with Friend Functions, Assignment Operator Overloading L18 Inheritance and Member Accessibility, Constructors		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			and Destructors in Derived Classes L19-L20 Overloaded Member Functions, Abstract Classes, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Multipath Inheritance and Virtual Base Classes, Hybrid Inheritance L21 Virtual Functions, Abstract Classes, Dynamic Binding Implementation L22-L23 Function Templates, Overloaded Function Templates, Multiple Arguments Function Template, User Defined Template Arguments L24-L25 Class Templates, Inheritance of Class Template L26 Console I/O, Stream Classes, Unformatted and Formatted I/O Operation, Managing Output with Manipulators L27-L28 File Handling, File Pointers and their Manipulations, Sequential I/O Operations, Updating a File, Error Handling during File Operation L29-L30 Exception Handling, Use of Standard Template Library (STL)		
Semester III					
17	**CS 213** Design and Analysis of Algorithms	On successful completion of the course students will be able to • Analyze the performance of various algorithms in terms of time and space. • Solve recurrence relations and compute complexity of various iterative and recursive algorithm. • Understand the concept and design algorithm using data	**Section-A** Analysis of an algorithm, Time and Space complexity, Asymptotic notation to represent complexity of an algorithm, Recurrences- substitution method, iteration method and master method. Advance Data Structures: Threaded Tree, B-Tree, Heap and Heap Sort, Union and Find operations on Disjoint Set, Hashing, Representation of Graph and Breadth First & Depth First Traversal of Graph. **Section-B** ***Divide and Conquer***: General method, Max-Min, Binary Search, Merge Sort, Quick Sort, and Matrix Multiplication. ***Greedy Technique***: General Method, Knapsack Problem, Job Sequencing, Optimal Merge Patterns, Minimum Spanning Tree,		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		structures including threaded binary tree, B-Tree and hashing techniques. • Understand numerous algorithm design techniques including divide& conquer, greedy, dynamic programming, backtracking and branch& bound. • Choose appropriate algorithm design techniques for solving real world problems.	Single Source Shortest Path. ***Dynamic Programming***: General Method, 0/1 Knapsack Problem, Traveling Salesman Problem. **Section-C** ***Backtracking***: General Method, N Queen Problem, Sum of Subsets Problem, Graph Coloring Problem, 0/1 Knapsack Problem. ***Branch and Bound***: General Method, 0/1 Knapsack Problem, Traveling Salesman Problem, NP Hard & NP Complete Problems: Basic Concepts, Deterministic & Non Deterministic Polynomial Time Algorithms, Tractability, Examples of NP Hard & NP Complete Problems. **Suggested Books:** 1. Horowitz, E., & Sahni, S., & Rajasekaran, S. (2008). Fundamentals of Computer Algorithms (2nd ed.).University Press. 2. Knuth,D. E. (1997).*The Art of Computer Programming v.1. Fundamental algorithms (3rd ed.)*, Pearson Education. 3. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2001). *Introduction to Algorithms* (2nd ed.).MIT Press. 4. Berman, K.A., &Paul, J.L. (2002).*Algorithms.* Cengage Learning 5. Basu, S.K. (2005).*Design and Analysis of Algorithm*, PHI Learning.	**Suggested Books:** 1. Horowitz, E., & Sahni, S., & Rajasekaran, S. (2008). Fundamentals of Computer Algorithms (2nd ed.).University Press. 2. Knuth,D. E. (1997).*The Art of Computer Programming v.1. Fundamental algorithms (3rd ed.)*, Pearson Education. 3. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2001). *Introduction to Algorithms* (2nd ed.).MIT Press. 4. Berman, K.A., &Paul, J.L. (2002).*Algorithms.* Cengage Learning 5. Basu, S.K. (2005).*Design and Analysis of Algorithm*, PHI Learning. **Suggested E-Resources:** 1. Design and Analysis of Algorithms https://nptel.ac.in/courses/106101060/ 2. Algorithms Specialization https://www.coursera.org/specializations/algorithms 3. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein https://mcdtu.files.wordpress.com/2017/03/introduction-to-algorithms-3rd-edition-sep-2010.pdf	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
18	**CS 308** Operating Systems	On 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 and learn case study of Unix OS.	**Section-A** Operating system 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, Operating Systems for Embedded Devices, Introduction to popular operating systems like UNIX, DOS, Windows, etc. Parallel processing and distributed processing: concept, differences, OS. Process management: Process status, schedulers, scheduling algorithms Inter process communication: Shared memory and message passing, Process Synchronization, Critical Section problem and its hardware, software and semaphore solutions, classical problems in concurrent programming. **Section-B** Memory management: partition, paging and segmentation demand paging, virtual memory, page replacement algorithms, thrashing. Secondary storage: Disks, disk space management, Scheduling algorithms. Management file supports, access methods, allocation methods, contiguous, linked and indexed allocation, directory Systems I/O processor management: I/O traffic controller, I/O scheduler, I/O device handlers. **Section-C** Deadlock: Prevention, Avoidance, Detection and recovery. Protection and Security - Accessibility and Capability Lists UNIX: File System, Inode, Types of shells, Commands (basic, file mgmt, process mgmt, pipelines), vi editor, shell programming. **Suggested Books:** 1. Silberschatz, A., Gagne, G., & Galvin, P. B. (2003). *Operating System Concepts*(6th ed.). Addision	**Suggested Books:** 1. Silberschatz, A., Gagne, G., & Galvin, P. B. (2003). *Operating System Concepts*(6th ed.). Addision Wiley	No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Wiley Publications. 2. Godbole, A. S. (1995). *Operating Systems with Case Studies in Unix, Netware, Windows NT*. Tata McGraw-Hill Education. 3. Kanetkar, Y. P. (1997). *Unix Shell Programming*. BPB Publications. 4. Tanenbaum, A. S. (2009). *Modern Operating System*(3rd ed.). Pearson Education. 5. Dietel, H. M.(2003).*Operating Systems* (2nd ed.). Pearson Education.	Publications. 2. Godbole, A. S. (1995). *Operating Systems with Case Studies in Unix, Netware, Windows NT*. Tata McGraw-Hill Education. 3. Kanetkar, Y. P. (1997). *Unix Shell Programming*. BPB Publications. 4. Tanenbaum, A. S. (2009). *Modern Operating System*(3rd ed.). Pearson Education. 5. Dietel, H. M.(2003).*Operating Systems* (2nd ed.). Pearson Education. **Suggested E-Resources:** 1. Operating Systems https://nptel.ac.in/courses/106108101/ 2. Linux for Developers https://www.coursera.org/learn/linux-for-developers	
19	**CS 313** Software Engineering	On successful completion of the course students will be able to • Understand the software-development process and software-development life cycle. • Model object-oriented software systems. • Specify, design and construct CASE tools and application software. • Develop and apply testing strategies for software applications. • Identify some of the main risks of software development and use.	**Section-A** Software engineering concepts, historical perspective, software evaluation, program design paradigms. Software project planning : identifying software scope, resources, Feasibility study, cost/benefit analysis, information gathering, analysis concept, analysis modeling (behavioral model, data model, functional model), Need & Role of System Analyst. analysis tools & techniques, risk management, project scheduling, tracking. Cost estimation : project metrics, cost factors, cost estimation techniques (decomposition, empirical, automated estimation, delphi) **Section-B** System design : Design concepts & principles (modularization, abstraction, refinement, cohesion, coupling) design methods (structured design, database design, user interface design, object oriented design, real time system design), Implementation : modern programming language features & characteristics, language classes, coding style, efficiency. **Section-C** Software Quality Assurance : Risk management, Quality factors and criteria, SQA metrics, SQA techniques. Verification and Validation : software testing methods (WBT, BBT), software		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			testing strategy (Unit testing, integration testing, validation system, testing), System Implementation/conversion: Direct, parallel, Pilot, phased. Maintenance: Maintenance characteristics, Maintainability, software reuse, re-engineering, reverse engineering, CASE. **Suggested Books:** 1. Pressman, R. S. (1997). *Software Engineering: a practitioner's approach*(4th ed.). Tata McGraw-Hill. 2. Jalote, P. (2003).*An Integrated approach to Software Engineering*, Narosa Publications. 3. Awad, E. M., *Systems Analysis and Design*(2nd ed.). Galgotia Publications. 4. Rajaraman, V. *Analysis and Design of Information Systems* (2nd ed.). PHI Learning, New Delhi. 5. Fairley, R.(1997).*Software Engineering Concepts*. Tata McGraw- Hill. 6. Mall, R. (2004). *Fundamentals of Software Engineering*. PHI Learning, New Delhi. **7.** Sommerville, I. (2008). *Software Engineering*. Pearson Education.	**Suggested Books:** 1. Pressman, R. S. (1997). *Software Engineering: a practitioner's approach*(4th ed.). Tata McGraw-Hill. 2. Jalote, P. (2003).*An Integrated approach to Software Engineering*, Narosa Publications. 3. Awad, E. M., *Systems Analysis and Design*(2nd ed.). Galgotia Publications. 4. Rajaraman, V. *Analysis and Design of Information Systems* (2nd ed.). PHI Learning, New Delhi. 5. Fairley, R.(1997).*Software Engineering Concepts*. Tata McGraw- Hill. 6. Mall, R. (2004). *Fundamentals of Software Engineering*. PHI Learning, New Delhi. 7. Sommerville, I. (2008). *Software Engineering*. Pearson Education. **Suggested E-Resources:** 1. Software Engineering https://nptel.ac.in/courses/106101061/ 2. Software Engineering http://qiau.ac.ir/teacher/files/911610/13-11-1387-17-31-03.pdf	
20	**CS 315** Theory of Computation	On successful completion of the course students will be able to • Understand basic concepts and abstract models of computing, including deterministic (DFA), non-deterministic (NFA),	**Section-A** Mathematical preliminaries, alphabets, strings, Languages, states, transitions, automata with & without output(Mealy & Moore machine) and regular expressions, applications e.g. Lexical analyzers and text editors, the pumping Lemma & closure property of regular sets, decision algorithms for regular sets. **Section-B**		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Push Down Automata (PDA) and Turing (TM) machine model. • Understand the application of machine models and descriptors to compiler theory and parsing. • Relate practical problems to languages, automata, computability, and complexity. • Apply mathematical and formal techniques for solving problems in computer science. • Understand the relationship among language classes and grammars with the help of Chomsky Hierarchy.	Context free grammars, Chomsky and Greibach normal form theorems, ambiguity, Pushdown automata and the equivalence of context free languages to sets accepted by non-deterministic PDA, the Pumping Lemma for CFL's, closure properties of CFL's and decision algorithms for CFL's. **Section-C** Turing Machines: Introduction, Turing hypothesis, Turing computability, nondeterministic, multitape and other versions of Turing machine, Church's hypothesis, primitive recursive function, Godelization, recursively enumerable Languages and Turing Computability. Undecidability: Universal Turing machines and unsolvability of the halting problem, an undecidable problem, Post's Correspondence problem. **Suggested Books:** 1. Hopcroft J.E. & Ullman J.D. (2002).*Introduction to Automata Theory, Languages and Computation* (1st ed.). Narosa Publishing House. 2. Mishra, K. L. P., & Chandrasekaran, N. (2006). *Theory of Computer Science: Automata, Languages and Computation*. PHI Learning, New Delhi. 3. Wood, D., (1987). *Theory of Computation*(1st ed.). Harper & Row Publishers, New York. 4. Lewis, H. R., & Papadimitriou, C. H. (2001). *Elements of the Theory of Computation* (1st ed.). Prentice Hall International Inc.	**Suggested Books:** 1. Hopcroft J.E. & Ullman J.D. (2002).*Introduction to Automata Theory, Languages and Computation* (1st ed.). Narosa Publishing House. 2. Mishra, K. L. P., & Chandrasekaran, N. (2006). *Theory of Computer Science: Automata, Languages and Computation*. PHI Learning, New Delhi. 3. Wood, D., (1987). *Theory of Computation*(1st ed.). Harper & Row Publishers, New York. 4. Lewis, H. R., & Papadimitriou, C. H. (2001). *Elements of the Theory of Computation* (1st ed.). Prentice Hall International Inc. **Suggested E-Resources:** 1. Theory of Computation https://nptel.ac.in/courses/106104028/ 2. An Introduction to Formal Languages and Automata http://almuhammadi.com/sultan/books/Linz.5ed.pdf	
21	**CS 423** Java Programming	On completion of the course students will able to • Understand concept of Object Oriented	**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,		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Programming & Java Programming Constructs. • Understand the basic concepts of Java such as Operators, Classes, Objects, Interface, Inheritance, Packages, Enumeration and various keywords. • Understand the concept of Exception Handling, Collections, Input/output operations, Socket Programming, Database Connectivity. • Design the applications of Java, Swing, Applet and JSP. • Analyze & design the concept of Event Handling and Abstract Window Toolkit (AWT).	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 Overriding, 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 (Date, Calender, Random, Timer), Networking, Socket and Datagram Programming. **Section-C** JDBC, ODBC-JDBC Drivers, Types of Drivers, Prepared Statement and Callable Statement, Resultset, Metadata. Introduction to Web Browser and HTML, GUI in Java, Features of AWT and Swing, Layout Managers, Event handling, Adapter classes, Applets, Java Server Pages: tags and directives. **Suggested Books:** 1. Schildt, H. (2007). *Java : The Complete Reference* (7th ed.). Tata McGraw-Hill . 2. Rajagopalan, S., Rajamani, R., Ramesh, K., & Sridhar, V. (2002). *Java Servlet Programming Bible*.Wiley Dreamtech India Pvt. Ltd. 3. Balagurusamy, E. (2007). *Programming with JAVA – A Primer*(3rd ed.). Tata McGraw-Hill. 4. Mughal, K. A., & Rasmussen, R. W. (2009). *A Programmer's Guide to Java SCJP Certification: A Comprehensive Primer* (3rd ed.). Pearson Education. 5. Arnold, K., Gosling, J., & Holmes, D. (2000). *The Java Programming Language* (3rd ed.).Pearson Education. 6. Zukowski, J. (1998). *Mastering Java 2*. BPB Publications 7. Deitel, P.J., & Deitel, H.M. (2009). *Java: How to Program*(7th ed.). Pearson Education. 8. Horstmann, C. S., & Cornell, G. (2005). *Core Java 2 Volume I & II* (7th ed.). Pearson Education.	**Suggested Books:** 1. Schildt, H. (2007). *Java : The Complete Reference* (7th ed.). Tata McGraw-Hill . 2. Rajagopalan, S., Rajamani, R., Ramesh, K., & Sridhar, V. (2002). *Java Servlet Programming Bible*.Wiley Dreamtech India Pvt. Ltd. 3. Balagurusamy, E. (2007). *Programming with JAVA – A Primer*(3rd ed.). Tata McGraw-Hill. 4. Mughal, K. A., & Rasmussen, R. W. (2009). *A Programmer's Guide to Java SCJP Certification: A Comprehensive Primer* (3rd ed.). Pearson Education. 5. Arnold, K., Gosling, J., & Holmes, D. (2000). *The Java Programming Language* (3rd ed.).Pearson Education. 6. Zukowski, J. (1998). *Mastering Java 2*. BPB Publications 7. Deitel, P.J., & Deitel, H.M. (2009). *Java: How to Program*(7th ed.). Pearson Education. 8. Horstmann, C. S., & Cornell, G. (2005). *Core Java 2 Volume I & II* (7th ed.). Pearson Education.	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			9. Haecke, B. V. (2000). *JDBC3 Java Database Connectivity*. Wiley Dreamtech India Pvt. Ltd. 10. Bayross, I. (2005). *Web Enabled Commercial Applications Development Using... Java 2* (Revised ed.). BPB Publications. 11. Ganguli, M. (2002). *JSP: A Beginner's Guide*. Wiley Dreamtech India Pvt. Ltd. 12. Liang, Y. D. (2012). *Introduction to Java programming* (9th ed.). Pearson Education.	9. Haecke, B. V. (2000). *JDBC3 Java Database Connectivity*. Wiley Dreamtech India Pvt. Ltd. 10. Bayross, I. (2005). *Web Enabled Commercial Applications Development Using... Java 2* (Revised ed.). BPB Publications. 11. Ganguli, M. (2002). *JSP: A Beginner's Guide*. Wiley Dreamtech India Pvt. Ltd. 12. Liang, Y. D. (2012). *Introduction to Java programming* (9th ed.). Pearson Education. **Suggested E-Resources:** 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	
22	**TSKL 401** Communication Skills	On completion of the course students will able to • Understand and apply knowledge of human communication and language processes as they occur across various contexts. • Understand and evaluate key theoretical approaches used in the interdisciplinary field of communication. • Explain major theoretical frameworks, constructs, and concepts for the study of communication and languages.	**Section-A** Types of Communication- oral communication, written communication- formal, informal, Business letters – types of letter, writing letters, business correspondence, applying for job, Resume writing, filling out employment application. Language skills: constructing correct sentences by using the right tenses, prepositions, concord. Vocabulary building. **Section-B** Report writing- Defining and determining reports purpose, Report Planning, collecting information, Developing an outline, section of report, types of report, writing short reports, writing long project reports. Writing an abstract for a research paper, dissertation, project report, guidelines for writing a good abstract.Writing a project synopsis-research project synopsis and summer training project synopsis. Guidelines for writing a good research paper. **Section-C** Introduction to soft skills and hard skills, self development-etiquette and manners, positive attitude and self confidence, motivation skills, communication skills.		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		• Understand the research methods associated with the study of human communication. • Develop knowledge, skills, and judgment around human communication and communicate effectively orally and in writing.	Body language: Facial Expression, Posture, Gesture, eye contact, Appearance (Dress Code). Interpersonal Skills: Negotiations, listening skills, social skills, assertive skills, cross-cultural communications. Goal setting, priority management, time management & career planning. Resume building, Group discussions and Interview skills: Effective interview techniques, mock interviews, stress interviews. **Suggested Books:** 1. Raman, M., & Sharma, S. (2004). *Technical Communication: Principles and Practice*. Oxford University Press. 2. Kaul, A., (2009). Business Communication(2nd ed.). PHI Learning. 3. *SOFT SKILLS, 2015, Career Development Centre*, Green Pearl Publications. 4. Tyagi, K., & Misra, P. (2011). *Basic Technical Communication*. PHI Learning. 5. Sharma, S., & Mishra, B. (2009). *Communication Skills: For Engineers and Scientists*. PHI Learning. 6. Flatley, L. (2005). *Basic Business Communication*(10th ed.). Tata McGraw-Hill. 7. Flatley, L. (2008). *Business Communication:Making Connections in a Digital World*(11th ed.). Tata McGraw-Hill. 8. Chaturvedi, P. D., & Chaturvedi, M. (2011). *Business Communication* (2nd ed.). Pearson Education. 9. Covey S. (1998).*Seven Habit of Highly Effective Teens*. New York, Fireside Publishers. 10. Carnegie, D. (1998). *How to Win Friends & Influence People*.New York: Simon & Schuster. 11. Harris, T. A. (1972). *I am OK, You are OK*. New York-Harper and Row.	**Suggested Books:** 1. Raman, M., & Sharma, S. (2004). *Technical Communication: Principles and Practice*. Oxford University Press. 2. Kaul, A., (2009). Business Communication(2nd ed.). PHI Learning. 3. *SOFT SKILLS, 2015, Career Development Centre*, Green Pearl Publications. 4. Tyagi, K., & Misra, P. (2011). *Basic Technical Communication*. PHI Learning. 5. Sharma, S., & Mishra, B. (2009). *Communication Skills: For Engineers and Scientists*. PHI Learning. 6. Flatley, L. (2005). *Basic Business Communication*(10th ed.). Tata McGraw-Hill. 7. Flatley, L. (2008). *Business Communication:Making Connections in a Digital World*(11th ed.). Tata McGraw-Hill. 8. Chaturvedi, P. D., & Chaturvedi, M. (2011). *Business Communication* (2nd ed.). Pearson Education. 9. Covey S. (1998).*Seven Habit of Highly Effective Teens*. New York, Fireside Publishers. 10.Carnegie, D. (1998). *How to Win Friends & Influence People*.New York: Simon & Schuster. 11.Harris, T. A. (1972). *I am OK, You are OK*. New York-Harper and Row. **Suggested E-Resources:** 1. English Grammar & Composition https://www.mockbank.com/bulletin/wp-content/uploads/2016/01/Wren-and-Martin-IRDA-English-Preparation.pdf	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
23	**CS 213L** Design and Analysis of Algorithms Lab	On 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 No.** — **Problems** L1- 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-L12: Implementation of B Tree (Creation, Searching, Insertion) L13-L15: Implementation of Divide and Conquer Algorithms (Merge-Sort and Matrix Multiplications) L16-L20: Implementation of Greedy Knapsack problem, job sequencing with Deadline and Minimum spanning tree algorithms (Prims and Kruskal) L21-L23: Implementation of Signal source shortcut path Algorithms, DFS and BFS Algorithms. L24-L30: Implementation of N-Queens, Sun of Subset, Graph Coloring, 0/1 Knapsack Problem and Traveling Salesman Problem.		No change
24	**CS 308L** Operating Systems Lab	On 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.	**UNIX Shell Programming Assignment Lab** 1. Shell script to perform various arithmetic operations. 2. Shell script to find the factorial of a number. 3. Shell script to reverse a no. and check for the no. to be palindrome or not. 4. Shell script to find whether no. is prime or not. 5. Shell script to generate Fibonacci series. 6. Shell script to generate table of a given no. 7. Shell script to generate star pattern. * * * * * *		

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			* * * 8. Shell script to search a particular login entered by you. This program should continuously run on background to let you know about when that user has logged in. 9. Shell program for sorting a set of nos. The set of no. are to be entered through file. 10. Shell script to Generation and summation of natural numbers (and their various forms) e.g. 12 + 32 + 52 + ... 11. A shell script for binary to decimal conversion. 12-14. Shell program to generate and sum all prime numbers between any two given numbers. 15-17. Shell program for equivalent effect of the DOS command TYPE. 18-20. Shell script to protect a file through password. Password should be displayed in encrypted form.		
25	**CS 423L** Java Programming Lab	On 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 No. 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		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			L36 – L37 Programs based on Serialization L38 – L39 Programs based on Networking L40 – L41 Programs based on JDBC L42 – L45 Programs based on Servlets		
			Semester IV		
26	**CS 302** Data Communications and Networks	On successful completion of the course students will be able to • Understand concepts, data communication system components, network topologies, connecting devices and their functions. • Understand the OSI model and TCP/IP protocol suit. • Analyze the features and working of IPV4 and IPV6 including subnet mask. • Analyze the features and operations of various protocols such as HTTP, DNS, SMTP at application layer protocols. • Understand and can apply the features of Data Compression, Network and Data security.	**Section-A** Data Communication Model, tasks of a communication system, ~~***[networking,]***~~ analog and digital transmission, different transmission media. Data encoding: 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), ~~***[modems, interfacing [RS-232C]],***~~ multiplexing (TDM, FDM). **Section-B** Principles and Purpose of layered approach, OSI model, ~~***[ARPANET model],***~~ protocol architecture (OSI, TCP/IP) Data link control: Frame Synchronization asynchronous and synchronous; flow control- stop and wait, sliding window, go-back-N protocols; error detection- CRC, error control - ARQ schemes. Network switching - circuit switching, packet switching; routing and ~~***[congestion control; introduction to frame relay and ATM.]***~~ **Section-C** ~~***[High speed LANs;]***~~ network management; Internetworking, the Internet Protocol, ~~***[DNS and URL];***~~ transport protocols: TCP, UDP; ~~***[remote procedure call;]***~~ network security- encryption, RSA algorithm and ~~***[data compression,]***~~ applications – (~~***[Telnet],***~~ FTP, ~~***[SMTP],***~~ HTTP); ~~***[introduction to ISDN and broadband ISDN.]***~~ **Text Books:** [1] A.S. Tannanbaum: **Computer Networks**: PHI	**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. Stallings, W. *Data and Computer Communications* (5th ed.). PHI Learning.	Deleted some concepts related to modem and interfacing from existing syllabus technological advancement. Introduced WDM techniques of multiplexing. Deleted topic related to ATM and Frame Relay networks. Introduced MAC layer and MAC layer protocols. Removed concepts related to LAN and ISDN networks. Enhanced the IP

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			[2] W. Stailings: **Data and Computer Communications**: Pearson Education [3] Prakash C. Gupta: **Data Communication & Computer Networks**: PHI **Reference Books:** [1] Korose & Ross: **Computer Networking:** Pearson Education [2] Behrouz A. Fou Rouzan: **Data Communication & Networking:** Tata McGraw Hill	2. Forouzan, A. B. *Data Communications & Networking* (4th ed.). Tata McGraw-Hill. 3. Tanenbaum, A. S. *Computer Networks* (3rd ed.). PHI Learning. 4. Kurose, J. F., & Ross, K. W. (2009). *Computer Networking: a Top-Down Approach* (5th ed.). Pearson Education. 5. Gupta, P. C. (2013). *Data Communications and Computer Networks*. PHI Learning. 6. Couch, I. I., & Leon, W. (1998). *Modern Communication Systems: Principles and Applications.* PHI Learning. **Suggested E-Resources:** 1. Computer Networking: A Top-Down Approach https://www.bau.edu.jo/UserPortal/UserProfile/PostsAttach/10617_1870_1.pdf 2. Data Communication https://nptel.ac.in/courses/106105082/	Addressing concepts and network security.
27	**CS 406** Compiler Design	On 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	**Section-A** Analysis of source program, 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), Context free Grammar.. Errors in different phases of compiler. Introduction to Compiler Construction Tools. **Section-B** Parsing techniques: Top down parsers, Predictive parser Bottom-up parsers, Shift Reduce parsers, Operator-precedence parsing LR parsers : SLR, LR(1), LALR		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		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-C** Intermediate code generation : Intermediate language, syntax directed translation, assignment statement, Boolean statements and backpatching, array references, procedure calls and record structure. 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, U. (1989). *Principles of Compiler Design*. Narosa Publishing House. 2. Aho, Sethi, &Ullman (2007). *Compilers : Principles, Techniques and Tools*. Pearson Education. 3. Louden, K. C. (1997). *Compiler Construction: Theory & Practice*. Cengage Learning. 4. Sorenson, P. G., Tremblay, J. P. (1985). *The Theory and Applications of Compiler Writing*. B. S. Publications Hyderabad. 5. Muchnick, S. S. (1997). *Advanced Compiler Design Implementation*. Morgan Kaufmann.	**Suggested Books:** 1. Aho, U. (1989). *Principles of Compiler Design*. Narosa Publishing House. 2. Aho, Sethi, &Ullman (2007). *Compilers : Principles, Techniques and Tools*. Pearson Education. 3. Louden, K. C. (1997). *Compiler Construction: Theory & Practice*. Cengage Learning. 4. Sorenson, P. G., Tremblay, J. P. (1985). *The Theory and Applications of Compiler Writing*. B. S. Publications Hyderabad. 5. Muchnick, S. S. (1997). *Advanced Compiler Design Implementation*. Morgan Kaufmann. **Suggested E-Resources:** 1. Principles of Compiler Design https://nptel.ac.in/courses/106108113/ 2. Compilers https://web.stanford.edu/class/archive/cs/cs143/cs143.1128/	
28	**CS 419** Distributed Computing	On successful completion of the course students will be able to • Study software components, interconnection architecture and design	**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.		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		difficulties of distributed computing systems. • Understand design issues, communication and synchronization in distributed operating systems. • Understand scheduling in distributed operating systems. • Develop various synchronous and asynchronous algorithms. • Have in-depth knowledge of asynchronous shared memory model including various classical algorithms of mutual exclusion and resource allocation.	**Section-B** Distributed Algorithms : Introduction to distributed algorithms, synchronous and partial synchronous models, Algorithms in general synchronous leader election (LCR Algorithm, HS Algorithm, A Simple Flooding Algorithm) , Breadth first search, shortest path, Minimum Spanning Tree, Maximal Independent Set, Distributed consensus 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 (Dijkstra Mutual Exclusion Algorithm, Lockout-free Mutual Exclusion Algorithm, An algorithm using Single-Writer Shared Register, Bakery Algorithm), resource allocation (Dining Philosophers Problem, Right-Left Dining Philosophers Algorithm, Randomized Dining Philosopher Algorithm), Consensus, Asynchronous network model (Send/Receive Systems, Broadcast Systems, Multicast Systems), basic asynchronous network algorithms, shared memory Vs Networks. **Suggested Books:** 1. Sinha, P. K. (2002). *Distributed Operating Systems: Concepts and Design*. PHI Learning. 2. Tanenbaum, A. S. (2009). *Distributed Operating Systems*. Pearson Education . 3. Lynch, N. A. (2009). *Distributed Algorithms* (3rd ed.). Morgan Kaufmann Publications. 4. Rumelhart D.F, McClelland JI & PDP Group (1999).*Parallel Distributed Processing*, vol I&II, MIT Press. 5. Dony, R. D., & Haykin, S. (1999). *Neural Network Approaches to Image Compression* (2nd ed.). IEEE Press.	**Suggested Books:** 1. Sinha, P. K. (2002). *Distributed Operating Systems: Concepts and Design*. PHI Learning. 2. Tanenbaum, A. S. (2009). *Distributed Operating Systems*. Pearson Education . 3. Lynch, N. A. (2009). *Distributed Algorithms* (3rd ed.). Morgan Kaufmann Publications. 4. Rumelhart D.F, McClelland JI & PDP Group (1999).*Parallel Distributed Processing*, vol I&II, MIT Press. 5. Dony, R. D., & Haykin, S. (1999). *Neural Network Approaches to Image Compression* (2nd ed.). IEEE Press. **Suggested E-Resources:** 1. Distributed Systems https://nptel.ac.in/courses/106106168/ 2. Distributed Systems	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
				https://www.distributed-systems.net/index.php/books/distributed-systems-3rd-edition-2017/	
29	**CS 436** Web Development and .NET Framework	On successful completion of the course students will be able to • Develop working knowledge of C# programming constructs and the .NET Framework architecture. • Build and debug well-formed Web Forms with ASP. NET Controls • Perform form validation with validation controls and create custom controls with user controls. • Use of XML in ADO.NET and SQL server. • Use ADO.NET in a web application to read, insert, and update data in a database.	**Section-A** Introduction to .NET Framework, CLR, MSIL, Metadata, Namespaces, Console Applications using .NET Framework, C# Programming: Introduction, Tokens, Data Types, Variables, Operators, Control Statements, Methods, Arrays, String, Structures, Enumerations, Object Oriented Programming in C#, Classes and Objects, Encapsulation, Polymorphism, Inheritance, Interfaces and Collections, Properties, Exceptions Handling, Garbage Collector, Operator Overload Conversions Operators. **Section-B** Advance C#: Delegates, Events. Advance C# type Construction, Indexers, Generics, Threading, File Handling. Web Development: Basic Concept of Client-Server Architecture, Elements of Web, Website Design Phases, Characteristics of good Website, HTML, CSS, Client Side and Server Side Coding, Introduction to Scripting Languages (JavaScript, VBScript), Client-Side Validations. **Section-C** Web Application Development using ASP.NET with C#: Web Application in ASP.NET, IIS and Development Server, Migrating ASP Web Application to ASP.NET, Working with HTML Controls, Server Controls, Validation Controls, Working with Classes and Dynamic Link Library (DLL), Master Page, State Management in ASP.NET, Data Binding, Data Management with ADO.NET, Creating & Consuming XML Web Services, Navigation, Localization, Security, Packaging and Deploying ASP.NET Web Application. Introduction to AJAX. **Suggested Books:** 1. Schildt, H. (2008). *C# 4.0: The Complete Reference*. Tata McGraw-Hill. 2. Sklar, J. (2010). *Textbook of Web Design*.Publisher Course Technology.	**Suggested Books:** 1. Schildt, H. (2008). *C# 4.0: The Complete Reference*. Tata McGraw-Hill. 2. Sklar, J. (2010). *Textbook of Web Design*.Publisher Course Technology.	No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			3. Evjen, B., Hanselman, S., & Rader, D. (2008). *Professional ASP. NET 3.5 in C# and VB*. Wrox Publication. 4. *C# 2008 Programming: Covers .NET 3.5 (Black Book)*, Dreamtech Press. 5. Troelsen, A. (2007). *Pro C# With. Net 3.0*. Aprèss Publication, 2007	3. Evjen, B., Hanselman, S., & Rader, D. (2008). *Professional ASP. NET 3.5 in C# and VB*. Wrox Publication. 4. *C# 2008 Programming: Covers .NET 3.5 (Black Book)*, Dreamtech Press. 5. Troelsen, A. (2007). *Pro C# With. Net 3.0*. Aprèss Publication, 2007 **Suggested E-Resources:** 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/	
30	**CS 436L** Web Development and .NET Framework Lab	On successful completion of the course students will be able to • Create web based applications using C# and .NET. • Implement programs based on arrays, structures, inheritance, exception handling and event handling. • Create dynamic web applications using ADO.NET, ASP.NET and VB.NET. • Apply concepts related to server control, and master page in web development.	**Lab No.** **Problems** L1-L2 Introduction to Visual Studio .NET L3-L4 Create, Debug & Run Console Application in C# L5 Programs based on Control Statements L6-L8 Programs based on Classes & Inheritance L9-L10 Programs based on Arrays L11-L12 Programs based on Enumerations & structures L13-L14 Programs based on Interfaces & Collection L15 Programs based on Exception Handling L16-L17 Programs based on Strings L18-L19 Programs based on Event Handling L20-L21 Programs based on Indexers, Operator Overloading, Conversions, Generics L22-L23 Programs based on ADO.NET L24 Problems based on HTML forms (GET & POST) L25-L26 Problem based on ASP L27 Migrating ASP Web application to ASP.NET L28-L29 Problem based on HTML Controls		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			L30-L32 Problem based on Server Controls L33-L35 Problem based on Validation Server Control L36-L37 Problem based on Master Page L38-L39 Problem based on state management in ASP.NET L40-L41 Problem based on Data Management Using ADO.NET L42-L44 Problem based on LINQ L45-L46 Problem based on AJAX L47-L48 Problem based on packaging & deployment L49-L50 Introduction to Windows Application & VB.NET L51 Simple Problems based on Windows Form L52-L53 Problem based on Different Controls i.e. Boxes, Buttons, Labels, Check Boxes, Radio Buttons, List Boxes, Combo Boxes,, Picture Boxes inVB.NET L54-L55 Problem based on Scrollbars, Splitters, Timer, Menus, Tree Views, Toolbars, status bars L56 Problem based on Files I/O L57-L58 Problem based on Multiple Document Interface (MDI) L58-L60 Problem based on Dynamic Linked Libraries (DLL)		
			Semester V		
31	**5.1** Computer Graphics	On successful completion of the course students will be able to • Gain comprehensive knowledge about the principles and applications of computer graphics.	**Section-A** Components of Graphics Systems: Display devices - Refresh CRTS, Random scan and Raster scan monitors, colour CRT monitors, DVST, Plasma-panel displays, Hard copy devices-printers, plotters. Display processors-random scan systems, DVST systems, Raster scan systems. Interactive Input devices: Keyboards, touch panels, light pens, tablets, joysticks, trackball,		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		• Implement various algorithms for scan converting the basic geometrical output primitives, area filling and clipping. • Design graphics applications such as animations and games etc. • Realistically display 3-Dimensional images on 2-Dimensional plane using projections, shading and illumination models. • Get the skills to develop the real world graphics applications according to the industry requirements.	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 algorithms. Anti-aliasing lines. Bresenham's circle drawing algorithms. Character generation. Area filling: Scan line. Boundary-fill, Flood-fill algorithms. 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 Transformations: 3D co-ordinates. Basic 3D transformations. Rotation about arbitrary axis. Reflection, shear, viewing transformation. Projections : Perspective Projection-Mathematical Description, Perspective Anomalies, Parallel Projection-Orthographic Projection, Oblique Projection; Cavalier, Cabinet. Curved lines and Surfaces : Polygon surface, Bezier Curves and surfaces, Spline curves and surfaces. Fractals Geometry Methods: Introductions. Hidden surface and Hidden line removal algorithms: 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. (1997). *Computer Graphics: C Version* (2nd ed.). Pearson Education. 2. Rogers, D. F., & Adams, J. A. (1990). *Mathematical Elements for Computer Graphics* (2nd ed.). Tata	**Suggested Books:** 1. Hearn, D., & Baker, M. P. (1997). *Computer Graphics: C Version* (2nd ed.). Pearson Education. 2. Rogers, D. F., & Adams, J. A. (1990). *Mathematical Elements for Computer Graphics* (2nd ed.). Tata McGraw-	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			McGraw-Hill. 3. Newman, W. M., & Sproull, R. F. (1997). *Principles of Interactive Computer Graphics*(2nd ed.). Tata McGraw-Hill. 4. Harrington S. (1987).*Computer Graphics:A Programming Approach* (2nd ed.). Tata McGraw-Hill. 5. Foley, J.D., Dam, A. V., Feiner, S.K., &Hughes, J. F. (1996).*Computer Graphics:Principles and Practice* (2nd ed.). Pearson Education. 6. Plastock, R. A.,& Kalley G. (1992).*Theory and Problems of Computer Graphics Schaums Outline Series*. Tata McGraw-Hill. 7. Mukhopadhyay, A., & Chattopadhyay, A. (2007). *Introduction to Computer Graphics and Multimedia* (2nd ed.). Vikas Publishing House Pvt Ltd. 8. Rogers D. F. (1998). *Procedural Elements for Computer Graphics*(2nd ed.). Tata McGraw-Hill. 9. Zhigang, X., Plastock R. (1986).*Schaum's Outlines:Computer Graphics* (2nd ed.). Tata McGraw-Hill.	Hill. 3. Newman, W. M., & Sproull, R. F. (1997). *Principles of Interactive Computer Graphics*(2nd ed.). Tata McGraw-Hill. 4. Harrington S. (1987).*Computer Graphics:A Programming Approach* (2nd ed.). Tata McGraw-Hill. 5. Foley, J.D., Dam, A. V., Feiner, S.K., &Hughes, J. F. (1996).*Computer Graphics:Principles and Practice* (2nd ed.). Pearson Education. 6. Plastock, R. A.,& Kalley G. (1992).*Theory and Problems of Computer Graphics Schaums Outline Series*. Tata McGraw-Hill. 7. Mukhopadhyay, A., & Chattopadhyay, A. (2007). *Introduction to Computer Graphics and Multimedia* (2nd ed.). Vikas Publishing House Pvt Ltd. 8. Rogers D. F. (1998). *Procedural Elements for Computer Graphics*(2nd ed.). Tata McGraw-Hill. 9. Zhigang, X., Plastock R. (1986).*Schaum's Outlines:Computer Graphics* (2nd ed.). Tata McGraw-Hill. **Suggested E-Resources:** 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/	
32	**5.2** Artificial Intelligence	On successful completion of the course students will be able to • Develop algorithms based on game playing and heuristic searching. • Develop applications based on NLP concepts.	**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:** Knowledge representation tools, First order predicate calculus. Understanding Logic Programming Using PROLOG. Semantic Nets, Frames, production rules, knowledge base, the inference system, forward and backward deduction.		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		• Develop a cognitive agent.	**Section-B** Cognitive Computing: Introduction, Elements of Cognitive Systems. Understanding Complex Relationships Between Systems. Understanding Cognition. Transformation of Artificial Intelligence into Cognitive Computing Systems. Uses of Cognitive Computing Systems. System of Judgment and Choice. Designing a Cognitive System. Graining Insight from Data. Bringing Data into Cognitive System. Defining Objective. Defining Domain. Understanding the Intended Users and Defining their Attributes. Defining Questions and Exploring Insights. Creating and Refining the Corpora. Training and Testing. Understanding Natural Language, Parsing techniques, context free and transformational grammar, transition net, augmented transition nets, Fillmore's grammar, Shanks conceptual dependency. Grammar free analysers, Sentence generation, Translation. **Section-C** Enabling Reasoning in Cognitive Systems Through Probabilistic Learning: Bayesian Networks, Approximate Inference, Constructing Bayesian Networks. Markov Chains, Hidden Markov Model: Forward Algorithm, Viterbi Algorithm, Baum-Welch Algorithm. Application of Cognitive Computing: Enhancing the Shopping Experience. Leveraging the Connected World of Internet of Things. Voice of the Computer. Fraud Detection. Case Study of Cognitive Computing Systems. **Suggested Books:** 1. Russell, S. J., & Norvig, P. (2013). *Artificial Intelligence: A Modern Approach* (3rd ed.).PHI Learning. 2. Vernon, D. (2014). Artificial Cognitive Systems: A Primer. MIT Press. 3. Rich, E., & Knight, K. (2011). *Artificial Intelligence* (3rd ed.). Tata McGraw-Hill. 4. Patterson, D. W. (1990). *Introduction to Artificial Intelligence and Expert Systems*. PHI Learning. 5. Barr, A., Cohen, P. R., & Feigenbaum, E. A. (1982). *The*	**Suggested Books:** 1. Russell, S. J., & Norvig, P. (2013). *Artificial Intelligence: A Modern Approach* (3rd ed.).PHI Learning. 2. Vernon, D. (2014). Artificial Cognitive Systems: A Primer. MIT Press. 3. Rich, E., & Knight, K. (2011). *Artificial Intelligence* (3rd ed.). Tata McGraw-Hill. 4. Patterson, D. W. (1990). *Introduction to Artificial Intelligence and Expert Systems*. PHI Learning.	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Handbook of Artificial Intelligence. Addison-Wesley. 6. Allen, J. (1995). *Natural Language Understanding* (2nd ed.). Pearson Education India. 7. Nilsson N.J., (1991).*Principles of Artificial Intelligence*. Narosa Publishing. 8. Nilsson, N. J. (1998). *Artificial intelligence: A New Synthesis*. Morgan Kaufmann Inc. 9. Luger, G. F. (2002). *Artificial intelligence: Structures and Strategies for Complex Problem Solving*. Addison-Wesley. 10. Charniak E.,& McDermott D. (1985).*Introduction to Artificial Intelligence*. Addison-Wesley.	5. Barr, A., Cohen, P. R., & Feigenbaum, E. A. (1982). *The Handbook of Artificial Intelligence*. Addison-Wesley. 6. Allen, J. (1995). *Natural Language Understanding* (2nd ed.). Pearson Education India. 7. Nilsson N.J., (1991).*Principles of Artificial Intelligence*. Narosa Publishing. 8. Nilsson, N. J. (1998). *Artificial intelligence: A New Synthesis*. Morgan Kaufmann Inc. 9. Luger, G. F. (2002). *Artificial intelligence: Structures and Strategies for Complex Problem Solving*. Addison-Wesley. 10. Charniak E.,& McDermott D. (1985).*Introduction to Artificial Intelligence*. Addison-Wesley. **Suggested E-Resources:** 1. Artificial Intelligence https://nptel.ac.in/courses/106105077/ 2. Artificial Intelligence: Principles and Techniques https://web.stanford.edu/class/cs221/	
33	**5.3** Big Data Analytics	On successful completion of the course students will be able to • Understand big data systems and identify the main sources of Big Data in the real world. • Learn various frameworks and 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	**Section-A** Introduction to Big Data, Evolution, Structuring Big Data, Types of Big Data, 4 Vs, 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, Point Solutions, Data Visualization for Big Data. **Section-B** Gathering Data on a Distributed Environment. Architecture and 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 Map Reduce, Techniques		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		algorithms for large Datasets using Map Reduce techniques. • Apply the knowledge of Big Data gained to fully develop BDA applications for real life applications.	to Optimize MapReduce Jobs. Building and Executing Applications. Controlling Map Reduce Execution with Input Format, 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, T. (2012). *Hadoop: The Definitive Guide*. O'Reilly Media, Inc. 2. Miner, D., & Shook, A. (2012). *Map Reduce 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 Books:** 1. White, T. (2012). *Hadoop: The Definitive Guide*. O'Reilly Media, Inc. 2. Miner, D., & Shook, A. (2012). *Map Reduce 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-Resources:** 1. Big Data & Analytics http://www.cs.kent.edu/~jin/BigData/index.html 2. Big Data Specialization https://www.coursera.org/specializations/big-data	
34	Computer Graphics Lab	On successful completion of the course students will be able to • Implement various line drawing and circle drawing algorithms. • Implement algorithms	**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.		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		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.	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		

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			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.		
35	Big Data Analytics Lab	On successful completion of the course students will be able to • Perform Linux file & directory manipulation commands, process management commands and security related commands. • Understand cloudera, hadoop ecosysytem and hadoop file system. • Compile and execute MapReduce programming example in HDFS environment. • Work on database in Apache and other tools like Apache Hive and Apache PIG.		**Lab No. Program** 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 ecosysytem. 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	Lab exercises added

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
				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	
Electives - I & Electives - II					
36	**5.1** Parallel Computing	On successful completion of the course students will be able to • Develop computer program for different type of parallel computers. • Measure the performance of algorithm used and parallel computers. • Solve problem using parallel computers. • Optimize sequential code to parallel code and determine if they are worthwhile to parallelize. Develop, analyze and implement algorithm for parallel computers with shared memory and with distributed memory. • Analyze and perform development work related to use of parallel computers and	**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		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		are able to get placement in the govt. organization.	FFT on butterfly. Introduction to dataflow computers. Parallelism in logic programming. Programming parallel computers. **Suggested Books:** 1. Rajaraman, V. (1990). *Elements of Parallel Processing*. PHI Learning. 2. Quinn, M. J. (1978). *Designing Efficient Algorithms for Parallel Computers*. Tata McGraw-Hill. 3. Lakshmivaraha, S., & Dhall, S. K. (1990). *Analysis and Design of Parallel Algorithms: Arithmetic and Matrix Problems*. Tata McGraw-Hill, Inc.	**Suggested Books:** 1. Rajaraman, V. (1990). *Elements of Parallel Processing*. PHI Learning. 2. Quinn, M. J. (1978). *Designing Efficient Algorithms for Parallel Computers*. Tata McGraw-Hill. 3. Lakshmivaraha, S., & Dhall, S. K. (1990). *Analysis and Design of Parallel Algorithms: Arithmetic and Matrix Problems*. Tata McGraw-Hill, Inc. **Suggested E-Resources:** 1. Parallel Computing https://nptel.ac.in/courses/106102114/	
37	**5.2** Pattern Recognition and Image Processing	On successful completion of the course students will be able to • Use techniques of image processing and analysis such as filtering, segmentation and local features to solve image processing problems of real world application • Use image processing and pattern recognition techniques to detect objects and activities in images • Perform feature extraction, feature evaluation, Image Transforms, Image Enhancement,	**Section-A** Image processing introduction, linear systems, the Fourier transform, matrix theory results. Image perception, image sampling, Quantisation: the optimal mean square (LIoyd-max quantiser), visual quantizaiton. Image transforms: two dimensional orthogonal and unitary transforms, properties, one dimensional, 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 teach), clustering.		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		Restoration and Compression, Image Processing, and Image Analysis.	**Suggested Books:** 1. Jain, A. K. (1989). *Fundamentals of Digital Image Processing*(2nd ed.).PHI Learning. 2. Gonzalez, R. C., & Woods, R. E. (2002). *Digital Image Processing* (2nd ed.). Pearson Education 3. Rosenfeld, A., & Kak, A. C. (1982). *Digital Picture Processing* Academic Press, N. Y. 4. Pratt, W. K. (1991). *Digital Image Processing* (2nd ed.). John Willey and Sons. 5. Duda, R. O., Hart, P. E., & Stork, D. G. (1973). *Pattern Classification*. Willey Interscience Publication. 6. Friedman, M., & Kandel, A. (1990). *Introduction to Pattern Recognition: Statistical, Structural, Neural and Fuzzy Logic Approaches*. World Scientific Publishing Company.	**Suggested Books:** 1. Jain, A. K. (1989). *Fundamentals of Digital Image Processing*(2nd ed.).PHI Learning. 2. Gonzalez, R. C., & Woods, R. E. (2002). *Digital Image Processing* (2nd ed.). Pearson Education 3. Rosenfeld, A., & Kak, A. C. (1982). *Digital Picture Processing* Academic Press, N. Y. 4. Pratt, W. K. (1991). *Digital Image Processing* (2nd ed.). John Willey and Sons. 5. Duda, R. O., Hart, P. E., & Stork, D. G. (1973). *Pattern Classification*. Willey Interscience Publication. 6. Friedman, M., & Kandel, A. (1990). *Introduction to Pattern Recognition: Statistical, Structural, Neural and Fuzzy Logic Approaches*. World Scientific Publishing Company. **Suggested E-Learning Materials** 1. Digital Image Processing https://web.stanford.edu/class/ee368/ 2. Digital Image Processing https://nptel.ac.in/courses/117105079/	
38	**5.3** Real Time Systems	On successful completion of the course students will be able to • Explain fundamental principles for programming of real time systems with time and resource limitations. • Describe the foundation for programming languages developed for real time programming.	**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		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		• Account for how real time operating systems are designed and functions. • Use real time system programming languages and real time operating systems for real time applications. • Analyze real time systems with regard to keeping time and resource restrictions.	databases. **Section-C** Real time communication algorithms, Fault tolerance 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., & Shen, K.G. (1997).*Real Time Systems*. Tata McGraw-Hill. 2. Liu Jane W.S. (2000).*Real Time Systems*, Pearson Education. 3. Laplante, P. A. (1997). *Real Time Systems Design Analysis* (2nd ed.). PHI Learning.	**Suggested Books:** 1. Krishna, C.M., & Shen, K.G. (1997).*Real Time Systems*. Tata McGraw-Hill. 2. Liu Jane W.S. (2000).*Real Time Systems*, Pearson Education. 3. Laplante, P. A. (1997). *Real Time Systems Design Analysis* (2nd ed.). PHI Learning. **Suggested E-Resources:** 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	
39	**5.4** Soft Computing	On successful completion of the course students will be able to • Develop NN network based application. • Differentiate between supervised, unsupervised and reinforcement learning. • Apply fuzzy logic on	**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		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		real life problems. • Design Hybrid Systems viz Neuro-Fuzzy, Neuro-Genetic, Fuzzy-Genetic systems.	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. Haykin, S. (2009). *Neural Networks: A Comprehensive Foundation*. Pearson Education. 2. Klir, G. J., & Yuan, B. (2010). *Fuzzy Sets and Fuzzy Logic: Theory and Applications*. PHI Learning. 3. Goldberg, D. E. (2007).*Genetic Algorithms in Search Optimization and Machine Learning*. Pearson Education. 4. Jang, J. S. R. (2003). *Neuro-Fuzzy and Soft Computing; A Computational Approach to Learning and Machine Intelligence*. PHI Learning. 5. Freeman, J. A. (2002). *Algorithms, Applications, and Programming Techniques*. Pearson Education. 6. Bart, K. (2003). *Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence*. PHI Learning. 7. Li, H. (1995). *Fuzzy Logic and Intelligent Systems*. Kluwer Academic. 8. Zimmermann, H. J. (1996). *Fuzzy Set Theory and Applications*. Allied Publishers. 9. Driankov, D. (1996). *An Introduction to Fuzzy Control*. Narosa. 10. Mitchell, M. (1996). *An Introduction to Genetic Algorithms*. PHI Learning. 11. Rajasekaran, S.,& Pai, G. V. (2003). Neural Networks,	**Suggested Books:** 1. Haykin, S. (2009). *Neural Networks: A Comprehensive Foundation*. Pearson Education. 2. Klir, G. J., & Yuan, B. (2010). *Fuzzy Sets and Fuzzy Logic: Theory and Applications*. PHI Learning. 3. Goldberg, D. E. (2007).*Genetic Algorithms in Search Optimization and Machine Learning*. Pearson Education. 4. Jang, J. S. R. (2003). *Neuro-Fuzzy and Soft Computing; A Computational Approach to Learning and Machine Intelligence*. PHI Learning. 5. Freeman, J. A. (2002). *Algorithms, Applications, and Programming Techniques*. Pearson Education. 6. Bart, K. (2003). *Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence*. PHI Learning. 7. Li, H. (1995). *Fuzzy Logic and Intelligent Systems*. Kluwer Academic. 8. Zimmermann, H. J. (1996). *Fuzzy Set Theory and Applications*. Allied Publishers. 9. Driankov, D. (1996). *An Introduction to Fuzzy Control*. Narosa. 10. Mitchell, M. (1996). *An Introduction to Genetic Algorithms*. PHI Learning. 11. Rajasekaran, S.,& Pai, G. V. (2003). Neural Networks, Fuzzy Logic and *Genetic Algorithms: Synthesis and*	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Fuzzy Logic and *Genetic Algorithms: Synthesis and Applications*. PHI Learning. 12. Yegnanarayana, B. (2003). *Artificial Neural Networks*. PHI Learning.	*Applications*. PHI Learning. 12. Yegnanarayana, B. (2003). *Artificial Neural Networks*. PHI Learning. **Suggested E-Resources:** 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	
40	**5.5** Cloud Computing	**Learning Outcomes:** On successful completion of the course students will be able to • Apply cloud computing model in real application. • Use programming paradigms like MapReduce to create applications. • Operate cloud by installing virtual machines and apply migration. • Understand the challenges of cloud • Aware about the Access Control mechanisms of cloud.	Cloud Computing Fundamentals: Definition, Characteristics, ~~***[Architectural Influences, Technological Influences, Operational Influences]***~~**.** Cloud Architecture : Cloud delivery Models, Cloud Deployment Model, Cloud Computing Stack, Benefits, ~~***[Limitation.]***~~ Web Technologies for Cloud : Data Format (XML, JSON) Web services: SOAP and REST, SOAP vs REST ~~***[AJAX: Asynchronous 'rich' interfaces, Mashups: user interface services, Role of AJAX and Mashups in Cloud.]***~~ System Level Virtualization: *Virtualization Technology:* Hypervisiors, Virtual machine technology, virtualization applications in enterprises, Pitfalls of Virtualization, Examples of Infrastructure as a Service (AmazonEC2, ~~***[Aneka]***~~, Open Stack), Platform as a Service (Azure, Goggle App Engine). ~~***[Application Virtualization: Multitenant software: Multi entity support, Multi schema approach, Multitenance using cloud data stores, Data access control for enterprise applications.]***~~ Data in the cloud: ~~***[Relational databases]***~~, Cloud file systems: GFS And HDFS, Big Table, HBase, Map-Reduce, ~~***[Example of Software as a Service (Google Apps, Salesforce.com)]***~~ Cloud computing security challenges: Virtualization security	**Section-A** **Cloud Computing Fundamentals:** Definition, Characteristics, Evolution, Architecture, deployment models and service models, Cloud Computing Stack, Applications, Benefits, and Limitation. **Web Technologies for Cloud:** Service Oriented Architecture, Web 2.0, Web services, Data Format (XML, JSON). **Virtualization Technology:** Overview, Architecture, Virtual machine technology, Virtual Machine Provisioning & Migration, Fault Tolerance Mechanisms. virtualization of data centers. **Section-B** Resource Management and Load Balancing: Distributed Management of Virtual Infrastructures, Server consolidation, Dynamic provisioning and resource management, Resource Optimization, Resource dynamic reconfiguration, Scheduling Techniques for Advance Reservation, Capacity Management to meet SLA Requirements, and Load Balancing, various load balancing techniques. Interoperability: Issues with interoperability, Federated clouds, Cloud federation stack, Interoperability approaches. **Implementation:** Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine, and Microsoft Azure, Build Private/Hybrid Cloud using open source tools (OpenStack**, Docker).** **Section-C**	Moved Virtualization Technology from Section-B of existing syllabus to Section-A of the proposed syllabus (with details of sub-topics). Introduced new concepts of resource management, load balancing & cloud interoperability due to technological advancement in cloud computing. Moved data intensive computing topics from Section-B of existing syllabus to Section-C of the proposed syllabus. Introduced advanced topics in cloud computing due to new

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			management Virtual Threats, VM Security Recommendations, VM-Specific Security techniques. Cloud computing security architecture: Architectural Considerations- General Issues, Trusted Cloud Computing, Secure Execution Environments and Communications, Micro-architectures; Identity Management and Access Control Identity management, Access control, Autonomic Security. Cloud computing Life Cycle Issues: Standards (DMTF, ISO), ~~***[Encryption and Key Management, Retirement.]***~~ **Text Books:** **Text Reference/Books : Suggested** 1. Krutz R., Vines R.D., "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley Publication, 2010. 2. Shroff G. "Enterprise Cloud Computing", Cambrige University Press, 2010 3. Malhar T., Cloud Security & Privacy by Tim Malhar, S. Kumkkaraswammy, S. Latif (SPD, O'REILLY) 4. Antohy T Velte, Et.al, "Cloud Computing: A Practical Approach". McGraw Hill. 5. Saurabh K. "Cloud Computing", First Edition, Wiley India Pvt. Ltd. 2011. 6. Sosinsky B. "Cloud Computing Bible", Wiley India Pvt. Ltd. 2011. 7. Stefano Ferretti et.al., "QoS-aware Clouds", 2010 IEEE 3rd International Conference on Cloud Computing.	**Data In Cloud:** Characterizing data-intensive computations, Technologies for data-intensive computing, Cloud file systems:GFS And HDFS, NoSQL systems: Big Table, HBase, Programming platforms: Map-Reduce. **Cloud Security:** Vulnerability Issues and Security Threats, Application-level, Security, Data level Security, and Virtual Machine level Security, Infrastructure Security, and Multi-tenancy Issues. Advances: Energy efficiency in clouds, Green Computing, Fog Computing, Mobile Cloud Computing, Cloud Standards. **Suggested Books:** 1. Krutz, R. L., & Vines, R. D. (2010). *Cloud Security: A Comprehensive Guide to Secure Cloud Computing*. Wiley Publication. 2. Shroff, G. (2010). *Enterprise Cloud Computing: Technology, Architecture, Applications*. Cambridge University Press. 3. Mather, T., Kumaraswamy, S., & Latif, S. (2009). *Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance*. O'Reilly Media, Inc. 4. Velte, A. T., Velte, T. J., Elsenpeter, R. C., & Elsenpeter, R. C. (2010). *Cloud Computing: A Practical Approach*. Tata McGraw-Hill. 5. Saurabh K. (2011). *Cloud Computing* (1st ed.). WILEY India Pvt. Ltd. 6. Sosinsky, B. (2011). *Cloud Computing*. WILEY India Pvt. Ltd. 7. Ferretti, S., Ghini, V., Panzieri, F., Pellegrini, M., & Turrini, E. (2010). *QoS–Aware Clouds*. IEEE 3rd International Conference on Cloud Computing. **Suggested E-Resources:** 1. Cloud Computing https://nptel.ac.in/courses/106105167/1 2. Cloud Computing Specialization	emerging trends.

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
				https://www.coursera.org/specializations/cloud-computing	
41	**5.6** Data Warehouse and Data Mining	On successful completion of the course students will be able to • Identify the scope and necessity of Data Mining & Warehousing for the society. • Describe the designing of Data Warehousing so that it can be able to solve the root problems. • Understand various tools of Data Mining and their techniques to solve the real time problems. • Develop ability to design various algorithms based on data mining tools. • Develop further interest in research and design of new Data Mining techniques.	**Section- A** Introduction to Business Intelligence, Decision support system, Knowledge discovery & decision making, need for data warehouse, definitions of Data warehousing and data mining, common characteristics of Data warehouse, Data Marts, Metadata, Operational versus analytical databases, trends and planning of Data warehousing, Defining business requirements, Data Warehouse Architecture, Data modeling strategy, Fact tables, dimensions, Star schema and other schemas, Multi dimensional data models, Data Cube presentation of fact tables, using the Data warehouse, OLAP models and operations, Implementation of Data warehouse Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, issues in Data Mining, Data Preprocessing: Needs Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation **Section- B** Data Mining Primitives, Languages, and System Architectures: Data Mining Primitives, Data Mining Query Languages, Architectures of Data Mining Systems, Concepts Description: Characterization and Comparison: Data Generalization and Summarization-Based Characterization, Analytical Characterization: Analysis of Attribute Relevance, Mining Class Comparisons: Discriminating between Different Classes, Mining Association Rules in Large Databases: Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Databases(Apriori,FP-tree), Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules **Section -C** Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining, Prediction, Classifier Accuracy, Cluster Analysis, Types of Data in Cluster Analysis,		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Major Clustering Methods (K means, Hierarchal clustering, DBSCAN), Mining Complex Types of Data: Multidimensional Analysis and Descriptive Mining of Complex, Spatial Mining, Multimedia Mining ,Time-Series and Sequence Data, Mining, Text Mining, Web Mining, Trends in Data Mining, Introduction to Various Data mining tools(SAS Enterprise Miner 5.1, Oracle Data Mining, SPSS Clementine 8.5) **Suggested Books:** 1. Kimball, R., Ross, M. (2008). *The Data Warehouse Lifecycle Toolkit* (2nd ed.). John Wiley & Sons. 2. Han, J., Kamber, M. (2011*). Data Mining: Concepts and Techniques* (2nd ed.). Elsevier. 3. Inmon, W. H. (2005). *Building the Data Warehouse* (4th ed.). John Wiley & sons. 4. Anahory, S., & Murray, D. (1997). *Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems*. Pearson Education.	**Suggested Books:** 1. Kimball, R., Ross, M. (2008). *The Data Warehouse Lifecycle Toolkit* (2nd ed.). John Wiley & Sons. 2. Han, J., Kamber, M. (2011*). Data Mining: Concepts and Techniques* (2nd ed.). Elsevier. 3. Inmon, W. H. (2005). *Building the Data Warehouse* (4th ed.). John Wiley & sons. 4. Anahory, S., & Murray, D. (1997). *Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems*. Pearson Education. **Suggested E-Resources:** 1. Data Mining https://nptel.ac.in/courses/106105174/ 2. Business intelligence and data warehousing https://www.coursera.org/learn/business-intelligence-data-warehousing	
42	**5.7** Mobile Computing	On successful completion of the course students will be able to • Have knowledge of fundamentals of mobile communication systems. • Choose system (TDMA/FDMA/CDMA) according to the complexity, installation cost, speed of transmission, channel properties etc.	**Section** A Introduction to Wireless Communication System : Evolution, Generations (1G, 2G, 2.5G, 3G), Wireless Transmission : Frequencies, ISM, Signals, Antennas; Signal propagation effects; Comparison of Wireless Communication Systems : Land-Mobile technologies (GSM, CDMA), Satellite Communication, In building Communication Systems, Personal Communication Systems. Cellular Concept : Basics & Traffic concepts, System Capacity, Trunking theory & GoS, Improving coverage & capacity - Frequency reuse. Cell Splitting/Sectoring, Umbrella cell, Breathing cell		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		• Identify the requirements of mobile communication as compared to static communication. • Identify the limitations of 2G and 2.5G wireless mobile communication and use design of 3G and beyond mobile communication systems.	**Section B** Wireless MAC protocols: S/F/T/CDMA, CSMA protocols, MACAW, Spread Spectrum : DSSS, FHSS; WWAN (GSM : Mobile services, System Architecture, Radio Interface, Protocols, Localization & Calling, Handover, Security, New Data Services; CDMA); WLAN (IEEE 802.11 : System architecture, Protocol architecture, MAC Management; H1PERLAN : Introduction), Mobile IP, MANET : Routing protocols, DHCP, Unicast & Multicast Communication; Wireless TCP; WPAN : Blue tooth, IEEE 802.15 (Introduction) **Section** C Mobile Computing: Challenges, Issues; Location & Data Management; Power management, Power-aware & Context-aware computing, Support for Mobility : WAP Introduction to Pervasive Computing - Applications, Devices, Software; Mobile Computing Software development : Strategies & Tools **Suggested Books:** 1. Schiller, J. H. *Mobile Communications*(2nd ed.). Pearson Education. 2. Stojmenovic, I. (2003). *Handbook of Wireless Networks and Mobile Computing*. John Wiley & Sons. 3. Rappaport, T. S. *Wireless Communications: Principles and Practice* (2nd ed.). PHI Learning. 4. Williams, V. *Wireless Computing Primer*. M & T Books. 5. Pandya, R. (1994). *Mobile and Personal Communication Systems and Services*. PHI Learning. 6. Hansmann, U., Merk, L., Nicklous, &M.S., Stober. *Pervasive Computing HandBook*. Springer. 7. Perkins, C. E., Alpert, S. R., & Woolf, B. (1998). *Mobile IP: Design Principles and Practices*. PHI Learning. 8. Garg, V. K. & Wilkis, J. E. (1996). *Wireless and Personal Communication*. PHI Learning. 9. Muller, N. J. (2001). *Bluetooth Demystified*. Tata	**Suggested Books:** 1. Schiller, J. H. *Mobile Communications*(2nd ed.). Pearson Education. 2. Stojmenovic, I. (2003). *Handbook of Wireless Networks and Mobile Computing*. John Wiley & Sons. 3. Rappaport, T. S. *Wireless Communications: Principles and Practice* (2nd ed.). PHI Learning. 4. Williams, V. *Wireless Computing Primer*. M & T Books. 5. Pandya, R. (1994). *Mobile and Personal Communication Systems and Services*. PHI Learning. 6. Hansmann, U., Merk, L., Nicklous, &M.S., Stober. *Pervasive Computing HandBook*. Springer. 7. Perkins, C. E., Alpert, S. R., & Woolf, B. (1998). *Mobile IP: Design Principles and Practices*. PHI Learning. 8. Garg, V. K. & Wilkis, J. E. (1996). *Wireless and Personal Communication*. PHI Learning. 9. Muller, N. J. (2001). *Bluetooth Demystified*. Tata McGraw-Hill.	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			McGraw-Hill. 10. Sturman, C. F., & Bray, J. *Bluetooth: Connect without Cables* (2nd ed.). Pearson Education. 11. Dhawan, C. (1997). Mobile Computing: A Systems Integrator's Handbook. Tata Mc-Graw-Hill	10. Sturman, C. F., & Bray, J. *Bluetooth: Connect without Cables* (2nd ed.). Pearson Education. 11. Dhawan, C. (1997). Mobile Computing: A Systems Integrator's Handbook. Tata Mc-Graw-Hill **Suggested E-Resources:** 1. Wireless Communications https://web.stanford.edu/class/ee359/ 2. Data Communications II http://mobile.cs.uml.edu/~glchen/cs414-564/handouts/	
43	**5.8** Modeling and Simulation	On successful completion of the course students will be able to • Understand basic concepts of modeling and simulation and classify various simulation models. • Construct a model for a given set of data and perform its validity. • Generate and test random number and apply them to develop simulation models. • Analyze output data produced by a model and test validity of the model. • Explain parallel and distributed simulation methods and know how to simulate any discrete system using queuing systems.	**Section-A** Definition of system, system concepts, types of system. Continuous & discrete system, Models :- compartmental model, Iinear and nonlinear model, stochastic model, Verification & validation Simulation: Introduction, classification of simulation models. Advantages & disadvantages of simulation. Discrete system simulation: Monte Carlo method, random no. generation, test of randomness, Probability Distributions and their random variates. **Section-B** Introduction to queuing theory: Queuing model with poison input, Exponential service & arbitrary service times, Simulation of queuing system, Simulation of single server queue; Simulation of two server queue, Application of queuing theory in computer system like operating system, computer network etc. Introduction to inventory theory, EOQ Models, More complex inventory models. **Section-C** [Introduction of Simulation of system dynamics model] Evaluation of simulation, length of simulation runs, Introduction to Variance reduction techniques. Project management: Simulation of Pert /CPM technique Models as component of information system *Modeling for decision support Virtual reality: ultimate interactive model*. [Simulation languages :- Simula. Dyanamo, Stella]		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Simulation language:- Simula (Basic facts, History of Simula I and 67, Data types, Statements, Procedure, Classes and Packages) **Suggested Books:** 1. Gordon, G. *System Simulation*. PHI Learning. 2. Deo, N.*System Simulation*. Tata Mcgraw-Hill. 3. Payne, J.A. *Introduction to Simulation.*Tata McGraw-Hill. 4. Law, A.M., Kelton W.D. *Simulation Modelling and Analysis.* Tata McGraw-Hill	**Suggested Books:** 1. Gordon, G. *System Simulation*. PHI Learning. 2. Deo, N.*System Simulation*. Tata Mcgraw-Hill. 3. Payne, J.A. *Introduction to Simulation.*Tata McGraw-Hill. 4. Law, A.M., Kelton W.D. *Simulation Modelling and Analysis.* Tata McGraw-Hill **Suggested E-Resources:** 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	
44	**5.9** Natural Language Processing	On successful completion of the course students will be able to • Develop algorithms based on NLP Concepts. • Develop applications based on Statistical Approaches of NLP. • Create applications for Indian Language Processing.	**Section-A** Introduction to Natural Language Understanding, Language as a knowledge base process, Processing Indian Languages, Basic linguistics. Morphology - Types and Parsing, N-gram Model, Maximum Likelihood Estimation, Smoothing techniques on N-gram Model, Words and Word Classes, POS Tagging. Grammar and Parsing - Top Down Parsing, Bottom-up Parsing, Dependency Grammar, Parsing Indian Languages. **Section-B** Meaning Representation, First Order Predicate Calculus, Elements of FOPC, Semantics and FOPC, Syntax Driven Semantic Analysis, Principle of Compositionally, Semantic Augmentation of CFG Rules, Robust Semantic Analysis, Introduction to Semantic Grammar, Structure of Words, Thematic Roles, Word Sense Disambiguation - Selectional Restrictions, Machine Learning Approaches, Dictionary Based		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Approaches **Section-C** Context and World Knowledge, Knowledge Representation and Reasoning, Discourse and World Knowledge, Cohesion, Reference Resolution, Various Resolution Algorithms, Discourse Coherence, Coherence Relations, Language Learning. **Suggested Books:** 1. Jurafsky, D., & Martin, J. H. (2000). *Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*. Pearson Education. 2. Allen, J. (1995). *Natural Language Understanding* (2nd ed.). Pearson Education. 3. Bharati, A., Chaitanya, V., Sangal, R., & Ramakrishnamacharyulu, K. V. (1995). *Natural language Processing: a Paninian Perspective*. PHI Learning. 4. Manning, C. D., Manning, C. D., & Schütze, H. (1999). *Foundations of Statistical Natural Language Processing*. MIT press. 5. Iwanska, L. M., Shapiro, S. C. (2001).*Natural Language Processing and Knowledge Representation*. Universities Press.	**Suggested Books:** 1. Jurafsky, D., & Martin, J. H. (2000). *Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*. Pearson Education. 2. Allen, J. (1995). *Natural Language Understanding* (2nd ed.). Pearson Education. 3. Bharati, A., Chaitanya, V., Sangal, R., & Ramakrishnamacharyulu, K. V. (1995). *Natural language Processing: a Paninian Perspective*. PHI Learning. 4. Manning, C. D., Manning, C. D., & Schütze, H. (1999). *Foundations of Statistical Natural Language Processing*. MIT press. 5. Iwanska, L. M., Shapiro, S. C. (2001).*Natural Language Processing and Knowledge Representation*. Universities Press. **Suggested E-Resources:** 1. Natural Language Processing https://www.coursera.org/learn/language-processing 2. Natural Language Processing https://nptel.ac.in/courses/106101007/	
45	**5.10** Cyber Security	On successful completion of the course students will be able to • Evaluate the computer network and information security needs of an organization. • Assess cyber security	**Section-A** Introduction to Cybersecurity, Cybersecurity: objectives, roles; Differences between Information Security & Cybersecurity. Cybersecurity Principles: The CIA triad (Confidentiality, integrity, & availability), Authentication & non-repudiation **Section-B** ~~***[Information Security (IS) within Lifecycle Management, Lifecycle management landscape, Security architecture***~~	**Section-A** **Information Security Concepts:** Introduction to Cyber security, Cyber security: objectives, roles. Differences between Information Security & Cyber security. Cyber security Principles: The CIA triad (Confidentiality, integrity,& availability Authentication & non-repudiation **Section-B** **Security Threats and vulnerabilities:** Overview of Security	Less relevant contents deleted. More relevant concepts are added in Section-B and Section-C.

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		risk management policies in order to adequately protect an organization's critical information and assets. • Troubleshoot, maintain and update an enterprise-level information security system and measure its performance. • Implement continuous network monitoring and provide real-time security solutions. • Formulate, update and communicate short- and long-term organizational cyber security strategies and policies.	~~*processes, Security architecture tools, Intermediate lifecycle management concepts,]*~~ Risks & Vulnerabilities, Basics of risk management **Section-C** ~~*[Operational threat environments, Classes of attacks, Incident Response, Incident categories Incident response, Incident recovery, Future Implications & Evolving Technologies, New & emerging IT & IS technologies Mobile security issues, risks, & vulnerabilities, Cloud concepts around data & collaboration]*~~ **Text Books:** 1. Chwan-Hwa (John) Wu, J. David Irwin Introduction to Computer Networks and Cyber security, CRC Press, 2012 2. Mark Dowd ,The Art of Software Security Assessment: Identifying and Preventing Software Vulnerabilities (2 Volume set) 1st Edition **Reference Books:** 1. James Graham, Richard Howard, Ryan Olson ., Cyber Security Essentials, CRC Press, 2012	threats, Risks & Vulnerabilities, Basics of risk management. Hacking Techniques, Password Cracking , Trends in the Types of Attacks and Malware **Hash and Authentication**: Authentication Overview, Hash Functions, The Properties of Hash Functions, Feasible Attacks to a Hash**.** Online Authentication: The One-Time Password and Token, Two-Factor Authentication, The OTP Standards. **Section-C** **Defensive measures for cyber security:** The Overview of Firewalls, Types of Firewalls, challenges. The intrusion detection system (IDS) and the intrusion prevention system (IPS), Digital Signature. **Cyberspace and the Law**: Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013. **Suggested Books** 1. Wu, C. H. J., & Irwin, J. D. (2016). *Introduction to Computer Networks and Cybersecurity*. CRC Press. 2. Dowd, M., McDonald, J., & Schuh, J. (2006). *The Art of Software Security Assessment: Identifying and Preventing Software Vulnerabilities* (1st ed.). Addison-Wesley Professional. 3. Graham, J., Olson, R., & Howard, R. (2016). *Cyber Security Essentials*. CRC Press, Taylor and Francis. **Suggested E-Resources:** 1. Cyber Security by courser website: https://www.coursera.org/learn/cyber-security-domain 2. Ahmad Kamal, The law of Cyber-Space an Invitation To The Table of Negotiations, UNITAR United Nations Institute of Training and Research, October 2005. 3. CYBER LAW - An exhaustive section wise Commentary on The Information Technology Act along with Rules, Regulations, Polices, Notifications etc. by Pavan Duggal	
46	**5.11** Digital	On successful	**Section-A**		

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
	Image Processing	completion of the course students will be able to • Explain how digital images are represented and manipulated in a computer, including reading and writing from storage, and displaying. Write a program which implements fundamental image processing algorithms. • Conversant with the mathematical description of image processing techniques • Know how to go from the equations to code.	Image processing: introduction, linear systems, the Fourier transforms, matrix theory results. Image Perception: Light, Luminance, Brightness, Contrast, MTF of Visual System, Visibility Function, Monochrome Vision Models and Color Vision Models, Temporal properties of vision.Image Sampling: 2-D sampling theory, Nyquist theorem. Image Quantization: Optimum Mean Square (Lloyd-Max) Quantizer, Compandor design. **Section-B** Image transforms: two dimensional orthogonal and unitary transforms, properties, one dimensional discrete Fourier transform (DFT), two dimensional DFT, Cosine transform, Sine transform. Image enhancement: point operation, histogram modelling, spatial operations, transform operation, multispectral image enhancement, false color and pseudocolor, color image enhancement. Image filtering and restoration: 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 labelling. Pattern recognition: Introduction, Recognition process, Statistical decision making (Bayes' theorem), Nonparametric decision making (Nearest neighbourhood classification techniques), Clustering. **Suggested Books:** 1. Jain A. K. (1989).*Fundamentals of Digital Image Processing.* PHI Learning. 2. Gonzalez, R. C., & Woods, R. E. (2008). *Digital Image Processing* (3rd ed.). Pearson Education. 3. Jayaraman S., Esakkirajan S., &Veerakumar T. (2009).*Digital Image Processing*. Tata McGraw-Hill. 4. Rosenfield, A., Kak A. C (1982).*Picture Processing*. NY: Academic Press. 5. Pratt, W. K. (1991). *Digital Image Processing* (2nd ed.). John Willey and Sons. 6. Duda R., Hart Peter, Stork D. (1973).*Pattern Classification*.	**Suggested Books:** 1. Jain A. K. (1989).*Fundamentals of Digital Image Processing.* PHI Learning. 2. Gonzalez, R. C., & Woods, R. E. (2008). *Digital Image Processing* (3rd ed.). Pearson Education. 3. Jayaraman S., Esakkirajan S., &Veerakumar T. (2009).*Digital Image Processing*. Tata McGraw-Hill. 4. Rosenfield, A., Kak A. C (1982).*Picture Processing*. NY: Academic Press. 5. Pratt, W. K. (1991). *Digital Image Processing* (2nd ed.). John Willey and Sons.	No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			Willey Interscience Publication. 7. Friedman, M., & Kandel, A. (1999). *Introduction to Pattern Recognition: Statistical, Structural, Neural and Fuzzy Logic Approaches*. World Scientific Publishing Company.	6. Duda R., Hart Peter, Stork D. (1973).*Pattern Classification*. Willey Interscience Publication. 7. Friedman, M., & Kandel, A. (1999). *Introduction to Pattern Recognition: Statistical, Structural, Neural and Fuzzy Logic Approaches*. World Scientific Publishing Company. **Suggested E-Resources:** 1. Digital Image Processing https://web.stanford.edu/class/ee368/ 2. Digital Image Processing https://nptel.ac.in/courses/117105079/	
47	**5.12** Digital Signal Processing	On successful completion of the course students will be able to • Describe the characteristics and transformations of discrete time signals mathematically. • Apply techniques in time and transform domains to the analysis and design of discrete-time systems • Estimate the spectra of deterministic and stochastic signals, and appropriately interpret the information contained therein • Demonstrate the ability to manipulate signals using analytical techniques and write algorithms to implement discrete-time systems • Describe the	**Section-A** Introduction of Signals, Systems and Signal Processing, Classification of Signals and Systems, Advantages of Digital over Analog Signal processing, Signal Models - Continuous Time versus Discrete time signals, Periodic and Aperiodic Signals, Phasor Signals and Spectra, Energy and Power Signals, System Modeling Concepts, The superposition integral for Fixed and Linear Systems, Impulse Response of a Fixed and Linear System - Fourier Series - Trigonometric Series- Exponential Fourier Series-Symmetry Properties of the Fourier Coefficients. Fourier Integral, Energy Spectral Density, Fourier Transforms in the Limit, Fourier Transform Theorems and Pairs, System Analysis with Fourier Transform, Laplace Transform Theorems, Network Analysis using the Laplace Transform. **Section-B** Discrete Time Signals and Systems - Review of Sampled Data Systems, Time Domain Representations of Discrete Time Signals, Frequency Domain Representation of Discrete Time Signals, Discrete Time Signals obtained by sampling, Discrete Fourier Transform. Z-Transform - Definition and Examples, Inverse Z-Transform, Properties of the Z-Transform, Introduction to Realization of Digital Systems - Block Diagrams and Signal Flow Graphs. Introduction to Realization of an IIR and FIR systems, Discrete Fourier Transforms (DFT)		

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		techniques for signal modulation and discriminate between the different modulation schemes used in communication systems	and Fast Fourier Transform (FFT). **Section-C** Design of Digital Filters : Introduction to Filters, A comparison of IIR and FIR Digital Filters. Design of IIR Digital Filters - Impulse Invariant Transformation, Bilinear Transformation, Design of Digital Butterworth and Chebyshev Filters. Design of FIR Digital Filters - Windowing and Rectangular Window, Filter Designs using Windows, Frequency Sampling Technique. DSP tools and DSP techniques in various applications. **Suggested Readings:** 1. Proakis J.G.,&Manolakis D.G. *Digital Signal Processing: Principles, Algorithms and Applications*(3rd ed.). PHI Learning. 2. Oppenheim, A. V., & Schafer, R. W. *Digital Signal Processing*. PHI Learning. 3. Nagarath, I.J., Sharan S.N., Ranjan R., & Kumar S. *Signals and Systems*.Tata McGraw-Hill. 4. Mitra, S.K. (2010). *Digital Signal Processing : A Computer Based Approach* (2nd ed.). Tata McGraw-Hill. 5. Defatta J.*Digital Signal Processing*. John Willey & Sons.	**Suggested Books:** 1. Proakis J.G.,&Manolakis D.G. *Digital Signal Processing: Principles, Algorithms and Applications*(3rd ed.). PHI Learning. 2. Oppenheim, A. V., & Schafer, R. W. *Digital Signal Processing*. PHI Learning. 3. Nagarath, I.J., Sharan S.N., Ranjan R., & Kumar S. *Signals and Systems*.Tata McGraw-Hill. 4. Mitra, S.K. (2010). *Digital Signal Processing : A Computer Based Approach* (2nd ed.). Tata McGraw-Hill. 5. Defatta J.*Digital Signal Processing*. John Willey & Sons. **Suggested E-Resources:** 1. Digital Image Processing https://web.stanford.edu/class/ee368/ 2. Digital Image Processing https://nptel.ac.in/courses/117105079/	
48	Human Computer Interaction	On successful completion of the course students will be able to • Develop effective UI. • Design menus using STM. • Develop applications based on cognitive architecture		**Section - A** Introduction to Human Computer Interaction: Need and advantages. Humans in HCI: Input-output channels; human memory; Reasoning and problem solving; emotional and psychological issues. Computers in HCI: Text entry devices; positioning, pointing and drawing; display devices; devices for virtual reality and 3D	Newly proposed elective course for MCA

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
				interaction; physical controls; printing and scanning; memory; processing and networks. Interaction Issues: Models of interaction; frameworks and HCI; Ergonomics; interaction styles; elements of WIMP interface; interactivity and the context of the interaction. **Section - B** Interaction Design Basics: Introduction to design; the process of design; user focus and scenarios; navigation design; screen design and layout; iteration and prototyping. HCI in the Software Process: Usability engineering; iterative design and prototyping; design rationale. Design Rules: Principles to support usability; standards and guidelines; golden rules and heuristics; HCI patterns. Section-C Cognitive Models: Introduction to cognitive models; goal and task hierarchies; linguistic models; the challenge of display-based systems; physical and device models; cognitive architectures. Socio-organizational Issues: Organizational issues including free rider problem, critical mass, workflow and BPR in automating processes; capturing requirements - stakeholders, socio-technical models, soft systems methodology, participatory design and ethnographic methods. Case Studies: HCI in health care; user-centered designs in games. **Suggested Books:** 1. Dix, A., Finlay, J., Abowd, G.D., & Beale, R. (2008). Human-Computer Interaction (3rd ed.). Pearson Education. 2. Carroll, J. M. (2002). Human-Computer Interaction in the	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
				New Millennium. Pearson Education.	
Semester VI					
Reading Electives					
49	6.1 Client - Server Computing and Applications	On 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.	Distributed systems and database. Client-Server computing model, client-server hardware and software needs, issue in client server computing-shared access, connectivity, security, Advantages of client-server computing. Example: UNIX and Windows NT. 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. *Client Server Computing* (1st ed.). Tata McGraw-Hill. 2. Berson, A. *Client Server Architecture*. Tata McGraw-Hill. 3. Orfali, R., Harkey, D., & Edwards, J. (2007). *Client Server Survival Guide* (3rd ed.). John Wiley & Sons. 4. Trivedi, M., Khanna, M.*Client Server Computing*. Book Publishing Co. Pvt. Ltd.	**Suggested Books:** 1. Dewire, D. T. *Client Server Computing* (1st ed.). Tata McGraw-Hill. 2. Berson, A. *Client Server Architecture*. Tata McGraw-Hill. 3. Orfali, R., Harkey, D., & Edwards, J. (2007). *Client Server Survival Guide* (3rd ed.). John Wiley & Sons. 4. Trivedi, M., Khanna, M.*Client Server Computing*. Book Publishing Co. Pvt. Ltd.	No change
50	6.2 Electronic Commerce	On 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-	**Section-A** Whats and hows of Internet: Development and growth, DNS, Commercialisation of internet. Introduction to e-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 TCP/IP based Networking, Multicast IP. Principles of Web Site Hosting and Promotion: Decision on Website Design, Legal issues, Domain Name Registration, Site		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
		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.	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 Information. Cyberlaws, Electronic payment systems: Digital cash. **Suggested Books:** 1. Turban, E., King, D., Lee, J., & Viehland, D. (2002). *Electronic Commerce: A Managerial Perspective*. PHI Learning. 2. Kalakota, R., & Whinston, A. B. *Frontiers of E-Commerce*. Pearson Education. 3. Chan, H., Lee, R., Dillon, T., & Chang, E. (2007*). E-Commerce: Fundamentals and Applications*. John Wiley & Sons.	**Suggested Books:** 1. Turban, E., King, D., Lee, J., & Viehland, D. (2002). *Electronic Commerce: A Managerial Perspective*. PHI Learning. 2. Kalakota, R., & Whinston, A. B. *Frontiers of E-Commerce*. Pearson Education. 3. Chan, H., Lee, R., Dillon, T., & Chang, E. (2007*). E-Commerce: Fundamentals and Applications*. John Wiley & Sons.	
51	6.3 Enterprise Resource Planning	On 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, M'RP-11, 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 andrelated 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, J1T & Kanban, PDM (Product Data Management) & its benefits, Data Management, MTO v/s		No change

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
			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.	**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.	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
52	Agile Software Development			**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-Resources:** 1. Agile Software Development https://www.edx.org/course/agile-software-development	Newly introduced course (online)
53	Organizational Behavior			**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**	Newly introduced course(online)

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
				• 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	

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
				Suggested E-Resources: 1. https://swayam.gov.in/courses/5148-organizational-behaviour 2. https://www.mooc-list.com/course/organizational-behavior-managing-people-coursera	
54	Software as a Service			**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-Resources:** 1. https://www.edx.org/course/software-service-uc-berkeleyx-cs-169-2x	Newly introduced course(online)
55	Blockchain			**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	Newly introduced course(online)

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remarks
				– 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-Resources:** 1. Blockchain https://www.coursera.org/learn/blockchain-basics	

* Matter in contrast (black background & white letters) is shifted to some other units, and material brought as a result of shift is also in contrast.
# Matter in square brackets, bold, italic and crossed is deleted.
@ Proposed added materials are shaded in grey.

Name of Programme: M.Tech. (Computer Science)

Programme Educational Objectives

The main objectives of the programme are:

- Practice with an expertise in academics, entrepreneurship, design and development in computing technology, or research in a specialized area of computer science and Engineering to pursue higher studies.
- Exhibit analytical, decision making and problem solving skills by applying research principles for handling real life problems with realistic constraints.
- Communicate the findings or express innovative ideas in an effective manner with an awareness of professional, social and ethical responsibilities.
- Practice and promote computing technologies for societal needs.
- Contribute to advancement of computer technology by means of research and lifelong learning.

Programme Outcomes

After completion of the course, the student will achieve the following:

- PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to evaluate, analyze, synthesize, model and integrate technologies to solve complex engineering problems.
- PO2. Problem analysis: Analyze complex engineering problems critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
- PO3. Design/development of solutions: Design and develop a system to provide a wide range of potential, feasible and optimal solutions for critical and challenging engineering problems to meet desired needs within social areas such as economics, environmental, and ethics.
- PO4. Conduct investigations of complex problems: Research Skill extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
- PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. PO7. Environment and sustainability: Understand contemporary issues in providing technology solutions for sustainable development considering impact on economic, social, political, and global issues and thereby contribute to the welfare of the society.
- PO8. Ethics: Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
- PO9. Individual and team work: Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
- PO10. Communication: Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
- PO11. Project management and finance: Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

- PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

Programme Scheme: M.Tech. (Computer Science)

Semester I

Existing					
Course Code	**CourseName**	**L**	**T**	**P**	**C**
CS 419	Distributed Computing	4	0	0	4
CS 431	Real Time Systems	4	0	0	4
CS 433	Soft Computing	4	0	0	4
CS 520L	Discipline Labs – I	0	0	12	6
	Elective – I	4	0	0	4
	Elective – II	4	0	0	4
	Total	20	0	12	26

Proposed					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Distributed Computing	4	0	0	4
	Real Time Systems	4	0	0	4
	Soft Computing	4	0	0	4
	Discipline Labs – I	0	0	12	6
	Discipline Elective – I	4	0	0	4
	Discipline Elective – II	4	0	0	4
	Total	20	0	12	26

Semester II

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 503	Advanced Computer Architecture	4	0	0	4
CS 505	Advanced Topics in Algorithms	4	0	0	4
CS 5211L	Discipline Labs – II	0	0	12	6
	Elective – III	4	0	0	4
	Elective – IV	4	0	0	4
	Elective – V	4	0	0	4
CS 523S	Seminar	0	0	2	1
	Total	20	0	14	27

Proposed					
Course Code	**CourseName**	**L**	**T**	**P**	**C**
To be filled by the office	Advanced Computer Architecture	4	0	0	4
	Advanced Topics in Algorithms	4	0	0	4
	Discipline Labs – II	0	0	12	6
	Discipline Elective – III	4	0	0	4
	Discipline Elective – IV	4	0	0	4
	Open Elective	4	0	0	4
	Seminar	0	0	2	1
	Total	20	0	14	27

Semester III

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
	Reading Elective – I	0	0	4	2
CS 604P	Project Part – I	0	0	48	24
	Total	0	0	52	26

Proposed					
Course Code	**CourseName**	**L**	**T**	**P**	**C**
To be filled by the office	Reading Elective – I	0	0	4	2
	UIL Project Part – I	0	0	48	24
	Total	0	0	52	26

Semester: IV

Existing					
Course Code	**CourseName**	**L**	**T**	**P**	**C**
	Reading Elective – II	0	0	4	2
CS 605P	Project Part – II	0	0	48	24
	Total	0	0	52	26

Proposed					
Course Code	**CourseName**	**L**	**T**	**P**	**C**
To be filled by the office	Reading Elective – II	0	0	4	2
	UIL Project Part – II	0	0	48	24
	Total	0	0	52	26

Existing **Elective - I, II, III, IV & V**							**Proposed** **Discipline Elective - I, II, III & IV**					
Course Code	**Course Name**	**L**	**T**	**P**	**C**		**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
CS 302	Data Communications and Networks	4	0	0	4		To be filled by the office	Data Communications and Networks	4	0	0	4
CS 314	Systems Programming	4	0	0	4			Systems Programming	4	0	0	4
CS 315	Theory of Computation	4	0	0	4			Theory of Computation	4	0	0	4
CS 406	Compiler Design	4	0	0	4			Compiler Design	4	0	0	4
CS 411	Computer Graphics	4	0	0	4			Computer Graphics	4	0	0	4
CS 417	Database Management Systems	4	0	0	4			Database Management Systems	4	0	0	4
CS 423	Java Programming	4	0	0	4			Java Programming	4	0	0	4
CS427	Parallel Computing	4	0	0	4			Parallel Computing	4	0	0	4
~~***CS 429***~~	~~***Pattern Recognition and Image Processing***~~	~~***4***~~	~~***0***~~	~~***0***~~	~~***4***~~			**Digital Image Processing**	**4**	**0**	**0**	**4**
CS 436	Web Development and .NET Framework	4	0	0	4			Web Development and .NET Framework	4	0	0	4
CS 501	Advanced Communication Networks	4	0	0	4			Advanced Communication Networks	4	0	0	4
CS 504	Advanced Java Programming	4	0	0	4			Advanced Java Programming	4	0	0	4
CS 507	Artificial Intelligence	4	0	0	4			Artificial Intelligence	4	0	0	4
CS 511	Cloud Computing	4	0	0	4			Cloud Computing	4	0	0	4
CS 514	Computer Architecture and Organization	4	0	0	4			Computer Architecture and Organization	4	0	0	4
CS 519	Data Warehouse and Data Mining	4	0	0	4			Data Warehouse and Data Mining	4	0	0	4
CS 526	Machine Translation	4	0	0	4			Machine Translation	4	0	0	4
CS 527	Mobile Computing	4	0	0	4			Mobile Computing	4	0	0	4
CS 528	Modeling and Simulation	4	0	0	4			Modeling and Simulation	4	0	0	4
CS 529	Natural Language Processing	4	0	0	4			Natural Language Processing	4	0	0	4
CS 530	Neural Networks	4	0	0	4			Neural Networks	4	0	0	4
ELE 502	Discrete Time Signal Processing	4	0	0	4			Discrete Time Signal Processing	4	0	0	4
ELE 503	Embedded Systems	4	0	0	4			Embedded Systems	4	0	0	4
ELE 505	Microprocessor and Microcomputer Applications	4	0	0	4			Microprocessor and Microcomputer Applications	4	0	0	4
IT 505	Geographic Information System	4	0	0	4			Geographic Information System	4	0	0	4
IT 506	Human Computer Interaction	4	0	0	4			Human Computer Interaction	4	0	0	4
IT 507	Information Retrieval	4	0	0	4			Information Retrieval	4	0	0	4
IT 511	System Testing	4	0	0	4			System Testing	4	0	0	4
								Big Data Analytics	**4**	**0**	**0**	**4**
								Internet of Things	**4**	**0**	**0**	**4**

Reading Elective - I & II Existing							**Reading Elective - I & II Proposed**					
Course Code	**Course Name**	**L**	**T**	**P**	**C**		**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
IT 402R	Electronic Commerce	0	0	4	2		To be filled by the office	Electronic Commerce	0	0	4	2
IT 403R	Enterprise Resource Planning	0	0	4	2			Enterprise Resource Planning	0	0	4	2
IT 601R	Information and Communication Technology	0	0	4	2			Information and Communication Technology	0	0	4	2
IT 604R	Semantic Web	0	0	4	2			Semantic Web	0	0	4	2
								Machine Learning	**0**	**0**	**4**	**2**
								Agile Software Development	**0**	**0**	**4**	**2**
								Blockchain	**0**	**0**	**4**	**2**

Name of Programme: M.Tech. (Information Technology)

Programme Educational Objectives

The main objectives of the programme are:

- Practice with an expertise in academics, entrepreneurship, design and development in information technology, or research in a specialized area of information technology to pursue higher studies.
- Identify and evaluate current and changing information system methodologies and assess their applicability in regulatory demands, strategic goals to address the clients' needs.
- Exhibit analytical, decision making and problem solving skills by applying research principles for handling real life problems with realistic constraints.
- Communicate the findings or express innovative ideas in an effective manner with an awareness of professional, social and ethical responsibilities.
- Practice and promote information technologies for societal needs.
- Contribute to advancement of information technology by means of research and lifelong learning.

Programme Outcomes

After completion of the course, the student will achieve the following:

- PO1. Engineering knowledge: Apply knowledge of Information Technology, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge to solve emerging IT based problems.
- PO2. Problem analysis: Analyze complex Information Technology related problems critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
- PO3. Design/development of solutions: Design and develop a system to provide a wide range of potential, feasible and optimal solutions for critical and challenging information technology based problems to meet desired needs within social areas such as economics, environmental, and ethics.
- PO4. Conduct investigations of complex problems: Research Skill extract information pertinent to unfamiliar problems in information technology domain through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
- PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools of information technology including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7. Environment and sustainability: Understand contemporary issues in providing IT solutions for sustainable development considering impact on economic, social, political, and global issues.
- PO8. Ethics: Acquire professional and intellectual integrity, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society using information technology solutions.
- PO9. Individual and team work: Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research.
- PO10. Communication: Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
- PO11. Project management and finance: Demonstrate knowledge and understanding of information technology and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

- PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

Programme Scheme: M.Tech. (Information Technology)

Semester I

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 533	Software Engineering	4	0	0	4
IT5 01	Advanced Database Management Systems	4	0	0	4
IT 504	Distributed Systems	4	0	0	4
IT 502L	Discipline Labs – I	0	0	12	6
	Elective – I	4	0	0	4
	Elective – II	4	0	0	4
	Total	20	0	12	26

Proposed					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Software Engineering	4	0	0	4
	Advanced Database Management Systems	4	0	0	4
	Distributed Systems	4	0	0	4
	Discipline Labs – I	0	0	12	6
	Discipline Elective – I	4	0	0	4
	Discipline Elective – II	4	0	0	4
	Total	20	0	12	26

Semester II

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CS 525	Information Security Systems	4	0	0	4
IT 510	Software Architecture and Project Management	4	0	0	4
IT 503L	Discipline Labs – II	0	0	12	6
	Elective – III	4	0	0	4
	Elective – IV	4	0	0	4
IT 508P	Minor Project	0	0	8	4
IT 509S	Seminar	0	0	2	1
	Total	16	0	22	27

Proposed					
Course Code	**CourseName**	**L**	**T**	**P**	**C**
To be filled by the office	Information Security Systems	4	0	0	4
	Software Architecture and Project Management	4	0	0	4
	Discipline Labs – II	0	0	12	6
	Discipline Elective – III	4	0	0	4
	Open Elective	4	0	0	4
	Minor Project	0	0	8	4
	Seminar	0	0	2	1
	Total	16	0	22	27

Semester III

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
	Reading Elective – I	0	0	4	2
IT 602P	Project Part – I	0	0	48	24
	Total	0	0	52	26

Proposed					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Reading Elective – I	0	0	4	2
	UIL Project Part – I	0	0	48	24
	Total	0	0	52	26

Semester IV

Existing					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
	Reading Elective – II	0	0	4	2
IT 603P	Project Part – II	0	0	48	24
	Total	0	0	52	26

Proposed					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
To be filled by the office	Reading Elective – II	0	0	4	2
	UIL Project Part – II	0	0	48	24
	Total	0	0	52	26

Existing

Elective - I, II, III & IV

Course Code	Course Name	L	T	P	C
CS 302	Data Communications and Networks	4	0	0	4
CS 314	Systems Programming	4	0	0	4
CS 315	Theory of Computation	4	0	0	4
CS 406	Compiler Design	4	0	0	4
CS 411	Computer Graphics	4	0	0	4
CS 417	Database Management Systems	4	0	0	4
CS 423	Java Programming	4	0	0	4
CS427	Parallel Computing	4	0	0	4
~~***CS 429***~~	~~***Pattern Recognition and Image Processing***~~	~~***4***~~	~~***0***~~	~~***0***~~	~~***4***~~
CS 436	Web Development and .NET Framework	4	0	0	4
CS 501	Advanced Communication Networks	4	0	0	4
CS 504	Advanced Java Programming	4	0	0	4
CS 507	Artificial Intelligence	4	0	0	4
CS 511	Cloud Computing	4	0	0	4
CS 514	Computer Architecture and Organization	4	0	0	4
CS 519	Data Warehouse and Data Mining	4	0	0	4
CS 526	Machine Translation	4	0	0	4
CS 527	Mobile Computing	4	0	0	4
CS 528	Modeling and Simulation	4	0	0	4
CS 529	Natural Language Processing	4	0	0	4
CS 530	Neural Networks	4	0	0	4
ELE 502	Discrete Time Signal Processing	4	0	0	4
ELE 503	Embedded Systems	4	0	0	4
ELE 505	Microprocessor and Microcomputer Applications	4	0	0	4
IT 505	Geographic Information System	4	0	0	4
IT 506	Human Computer Interaction	4	0	0	4
IT 507	Information Retrieval	4	0	0	4
IT 511	System Testing	4	0	0	4

Proposed

Discipline Elective - I, II & III

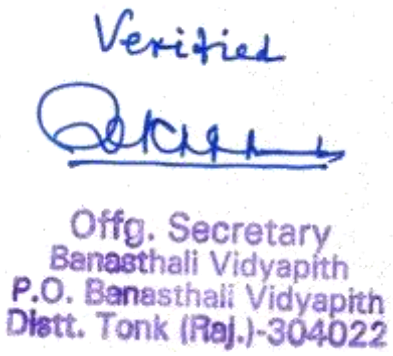
Course Code	Course Name	L	T	P	C
To be filled by the office	Data Communications and Networks	4	0	0	4
	Systems Programming	4	0	0	4
	Theory of Computation	4	0	0	4
	Compiler Design	4	0	0	4
	Computer Graphics	4	0	0	4
	Database Management Systems	4	0	0	4
	Java Programming	4	0	0	4
	Parallel Computing	4	0	0	4
	Digital Image Processing	**4**	**0**	**0**	**4**
	Web Development and .NET Framework	4	0	0	4
	Advanced Communication Networks	4	0	0	4
	Advanced Java Programming	4	0	0	4
	Artificial Intelligence	4	0	0	4
	Cloud Computing	4	0	0	4
	Computer Architecture and Organization	4	0	0	4
	Data Warehouse and Data Mining	4	0	0	4
	Machine Translation	4	0	0	4
	Mobile Computing	4	0	0	4
	Modeling and Simulation	4	0	0	4
	Natural Language Processing	4	0	0	4
	Neural Networks	4	0	0	4
	Discrete Time Signal Processing	4	0	0	4
	Embedded Systems	4	0	0	4
	Microprocessor and Microcomputer Applications	4	0	0	4
	Geographic Information System	4	0	0	4
	Human Computer Interaction	4	0	0	4
	Information Retrieval	4	0	0	4
	System Testing	4	0	0	4
	Big Data Analytics	**4**	**0**	**0**	**4**
	Internet of Things	**4**	**0**	**0**	**4**

Reading Elective - I & II
Existing

Course Code	Course Name	L	T	P	C
IT 402R	Electronic Commerce	0	0	4	2
IT 403R	Enterprise Resource Planning	0	0	4	2
IT 601R	Information and Communication Technology	0	0	4	2
IT 604R	Semantic Web	0	0	4	2

Reading Elective - I & II
Proposed

Course Code	Course Name	L	T	P	C
To be filled by the office	Electronic Commerce	0	0	4	2
	Enterprise Resource Planning	0	0	4	2
	Information and Communication Technology	0	0	4	2
	Semantic Web	0	0	4	2
	Machine Learning	**0**	**0**	**4**	**2**
	Agile Software Development	**0**	**0**	**4**	**2**
	Blockchain	**0**	**0**	**4**	**2**



वनस्थली विद्यापीठ

शैक्षिक परिषद् की बुधवार, 26 जुलाई, 2017 को सायं: 5:15 बजे समिति कक्ष, विद्या मंदिर, वनस्थली विद्यापीठ में सम्पन्न हुई बैठक का कार्य विवरण।

उपस्थिति

प्रो० आदित्य शास्त्री- कुलपति

1. डॉ. अजय सुराणा
2. प्रो. अनिता जैन
3. प्रो. बी.आर. नटराजन
4. डॉ. बालगोपाल सिंह
5. प्रो. भारती पाण्डेय
6. प्रो. चन्द्र कुमार झा
7. डॉ. चारू व्यास
8. श्रीमती गीता यादव
9. प्रो. धर्म किशोर
10. प्रो. दीपज्योति चक्रवती
11. प्रो. जी.एन. पुरोहित
12. प्रो. हम्सावाहिनी सिंह
13. प्रो. हर्ष पुरोहित
14. प्रो. हिमाद्री घोष
15. प्रो. ईना शास्त्री
16. प्रो. इन्दु बंसल
17. प्रो. इन्दु सिंह
18. प्रो. इला यादव
19. प्रो. कविता मित्तल
20. प्रो. जया द्विवेदी
21. प्रो. के.डी. जोशी
22. प्रो. किंशुक श्रीवास्तव
23. प्रो. किरन सरना
24. प्रो. कुसुम गुप्ता
25. डॉ. मनु शर्मा
26. प्रो. मोनिका जैन
27. प्रो. नीलम पारीक
28. प्रो. नीलिमा कुमारी
29. प्रो. निर्मला सिंह
30. प्रो. पीयूष कान्त राय
31. प्रो. प्रीति शर्मा
32. प्रो. प्रवीण ध्यानी
33. प्रो. प्रदीप कुमार सेठ
34. श्री प्रशान्त रमन
35. प्रो. रामप्रसाद रहारिया
36. डॉ. रश्मि शर्मा
37. प्रो. ऋतु विजय
38. डॉ. संतोष मीणा
39. डॉ. संगीता विजय
40. प्रो. सरला पारीक
41. प्रो. सर्वेश कुमार पालीवाल
42. डॉ. सतीश चन्द्र शुक्ला
43. डॉ. सीमा शर्मा
44. प्रो. सीमा वर्मा
45. प्रो. शालिनी चन्द्रा
46. प्रो. शर्मिला टेलर
47. श्रीमती शर्मिला गुर्जर
48. प्रो. सिद्धार्थ शास्त्री
49. प्रो. सोफी टाइटस
50. प्रो. सुधा शास्त्री
51. प्रो. सुमन पंत
52. प्रो. सुरेन्द्र पॉल
53. डॉ. उषा तिवारी
54. प्रो. वन्दना गोस्वामी
55. प्रो. विनय शर्मा
56. प्रो. वीना गर्ग
57. प्रो. वीना शर्मा

नोटः1. प्रो० चित्रा पुरोहित, अध्यक्ष, वनस्थली विद्यापीठ बैठक में उपस्थित हुई।

2. प्रो० आदित्य शास्त्री, कुलपति, वनस्थली विद्यापीठ ने बैठक की अध्यक्षता की।

3. डॉ. आशुतोष, श्री लोकेश शर्मा, प्रो. मंजु शुक्ला, प्रो. मंजु सिंह, डॉ. संजय कुमार शर्मा, प्रो. शील शर्मा एवं डॉ. वन्दना चौबे (आन्तरिक सदस्य) परिषद् की बैठक में उपस्थित नहीं हो सके।

बैठक की कार्यवाही प्रारंभ करने से पूर्व कुलपति द्वारा सभी सदस्यों का हार्दिक स्वागत किया गया। तत्पश्चात् निम्न कार्यसूचियों पर विस्तृत विचार-विमर्श के पश्चात् निर्णय लिये गयेः-

1. शैक्षिक परिषद् की 29 जुलाई, 2016 की बैठक के कार्य विवरण की पुष्टि।

कुलपति महोदय द्वारा बताया गया कि परिषद् की 29 जुलाई, 2016 को सम्पन्न हुई बैठक का कार्य विवरण सभी सदस्यों को प्रेषित किया जा चुका है। कार्य विवरण के अंकन में यदि कोई कमी रह गयी हो तो सदस्य अभी सभी सदस्यों का ध्यान आकर्षित कर सकते है। अन्यथा यह माना जायेगा कि कार्य विवरण सही रूप में तैयार किया गया है।

निश्चय किया कि परिषद् की 29 जुलाई, 2016 की बैठक की कार्य विवरण की पुष्टि की जाती है।

(Encl.-1)

2. शैक्षिक परिषद् की 29 जुलाई, 2016 की बैठक के कार्य विवरण पर की गयी कार्यवाही की सूचना।

कुलपति महोदय द्वारा बताया गया कि परिषद् की 29 जुलाई, 2016 को सम्पन्न हुई बैठक के कार्य-विवरण पर वांछित कार्यवाही पूर्ण कर ली गयी है जिसका विवरण कार्यालय द्वारा सदस्यों को प्रेषित किया गया है।

निश्चय किया कि परिषद् की 29 जुलाई, 2016 की बैठक के कार्य विवरण पर की गई कार्यवाही को अभिलिखित किया जाता है।

(Encl.-2)

3. वनस्थली विद्यापीठ के आधारभूत पाठ्यक्रमों के पुनर्गठन एवं पंचमुखी शिक्षा को पाठ्यक्रम में समाहित किये जाने सम्बन्धी प्रस्ताव पर विचार।

कुलपति महोदय द्वारा सदस्यों का ध्यान विद्यापीठ में संचालित आधारभूत पाठ्यक्रमों के पुनर्गठन एवं पंचमुखी शिक्षा को पाठ्यक्रम में समाहित किये जाने की ओर आकर्षित किया। कुलपति महोदय ने बताया कि आधारभूत विषयों की पाठ्य संरचना स्पष्ट इंगित हो एवं पंचमुखी शिक्षा को पाठ्यक्रम में सम्मिलित किए जाने पर जोर दिया।

निश्चय कर अनुशंसा की कि वनस्थली विद्यापीठ के आधारभूत पाठ्यक्रमों के पुनर्गठन एवं पंचमुखी शिक्षा को पाठ्यक्रम में समाहित किये जाने सम्बन्धी प्रस्ताव को स्वीकार किया जाता है।

4. दैनिक अध्ययन अध्यापन की प्रक्रिया को समुन्नत करने हेतु नीतियों के निर्धारण पर विचार।

कुलपति महोदय ने बताया कि विद्यापीठ में दैनिक अध्ययन अध्यापन को समुन्नत बनाने के लिए समस्त पाठ्यक्रम समितियों को विचार-विमर्श करना चाहिए।

निश्चय कर अनुशंसा की कि इस विषय पर परिषद् की आगामी बैठकों में विचार-विमर्श निरन्तर जारी रहेगा।

5. सतत् मूल्यांकन को अधिक प्रभावी तथा सुदृढ़ बनाने के तरीकों तथा साधनों पर विचार।

कुलपति महोदय द्वारा विचार व्यक्त किया गया कि हमें विद्यापीठ में सभी पाठ्यक्रमों हेतु एक समान सतत् मूल्यांकन प्रक्रिया होनी चाहिए। बेहतर यह हो कि सभी प्रश्नपत्रों हेतु 40 अंकों का सतत् मूल्यांकन (CA) एवं 60 अंकों की समसत्रीय परीक्षा (ESA) हो। परिषद् के सभी सदस्यों ने इस प्रस्ताव पर आम सहमति व्यक्त की।

निश्चय कर अनुशंसा की कि उपरोक्त प्रस्ताव स्वीकार किया जाता है। संशोधित नीति के अनुसार शैक्षिक सत्र 2017-18 से प्रवेश लेने वाली छात्राओं के लिए 40 अंकों का सतत् मूल्यांकन (CA) एवं 60 अंकों की समसत्रीय परीक्षा (ESA) होगी।

6. शैक्षिक सत्र 2017-2018 के शैक्षिक कैलेण्डर पर विचार।

निश्चय कर अनुशंसा की कि शैक्षिक सत्र 2017-18 के शैक्षिक कैलेण्डर को स्वीकार किया जाता है।

(Encl.-3)

7. प्रश्नपत्रों एवं परीक्षा प्रणाली की गुणवत्ता बढ़ाये जाने हेतु दिशा-निर्देश तैयार किये जाने पर विचार।

कुलपति महोदय ने बताया कि हमें प्रश्न-पत्रों की गुणवत्ता बढ़ाये जाने कि दिशा में गंभीरता से विचार करना चाहिए एवं इस सम्बन्ध में उचित शिक्षा निर्देश तैयार किये जाने चाहिए। परिषद् के सभी सदस्यों ने इस सम्बन्ध में आम सहमति व्यक्त की।

निश्चय कर अनुशंसा की कि प्रश्नपत्रों की गुणवत्ता बढ़ाये जाने हेतु दिशा-निर्देश तैयार किये जाने पर विचार-विमर्श निरन्तर जारी रहेगा।

8. 'Pass-by-year' vis-à-vis 'pass by Course' system पद्धति के सम्बन्ध में नीति की समीक्षा।

कुलपति महोदय ने प्रो० प्रवीण ध्यानी जी से अनुरोध किया कि वे परिषद् के समक्ष इस सम्बन्ध में संचालित नीति की समीक्षा प्रस्तुत करें, तत्पश्चात् प्रो० प्रवीण ध्यानी जी द्वारा उक्त नीति की समीक्षा का प्रस्तुतीकरण किया गया।

निश्चय कर अनुशंसा की कि 'Pass-by-year' vis-à-vis 'pass by Course' system पद्धति के सम्बन्ध में नीति पर विचार विमर्श जारी रहेगा।

9. IQAC द्वारा प्रस्तुत प्रतिपुष्टि (फीडबैक) विश्लेषण रिपोर्ट पर विचार।

कुलपति महोदय द्वारा सदस्यों को बताया गया कि सत्र 2016-17 के लिए छात्रओं, शिक्षकों, अभिभावको, एवं पूर्व छात्रओं ने अपने फीडबैक में विद्यपीठ के पाठ्यक्रमों को प्रासंगिक तथा संतोषजनक बताया। कुछ शिक्षकों एवं पूर्व छात्रओं ने पाठ्यक्रमों में वैकल्पिक कोर्सेज की संख्या को बढ़ाने का सुझाव दिया।

निश्चय कर अनुशंसा की कि IQAC द्वारा प्रस्तुत प्रतिपुष्टि (फीडबैक) विश्लेषण रिपोर्ट को स्वीकृत किया जाता है एवं सभी विभाग आगामी सत्र की बोर्ड ऑफ स्टडीज में वैकल्पिक कोर्सेज को बढ़ाने के संबंध में विचार करें।

(Encl.-4)

10. **शिक्षा संकाय** की दिनांक 24 जून, 2017 की बैठक की अनुशंसाओं पर विचार।

कुलपति महोदय द्वारा डीन, शिक्षा संकाय से अनुरोध किया गया कि वे संकाय की समस्त अनुशंसाओं का प्रस्तुतीकरण परिषद् के समक्ष प्रस्तुत करें। तत्पश्चात् डीन द्वारा संकाय की दिनांक 24 जून, 2017 को हुई बैठक की अनुशंसाओं का प्रस्तुतीकरण प्रस्तुत किया गया।

निश्चय कर अनुशंसा की कि शिक्षा संकाय की अनुशंसाओं को स्वीकार किया जाता है।

(Encl.-5)

11. रिसर्च बोर्ड की दिनांक 04 सितम्बर, 2016 की बैठक की अनुशंसाओं पर विचार।

कुलपति महोदय द्वारा सदस्यों को बताया गया कि **रिसर्च बोर्ड** की बैठक दिनांक 04 सितम्बर, 2016 को सम्पन्न हुई थी जिसकी अनुशंसाएँ परिषद् के समक्ष प्रस्तुत की गई है।

निश्चय कर अनुशंसा की कि रिसर्च बोर्ड की दिनांक 04 सितम्बर, 2016 की बैठक की अनुशंसाओं को यथावत स्वीकार किया जाता है।

(Encl.-6)

12. **ललित कला संकाय** की दिनांक 28 जून, 2017 की बैठक की अनुशंसाओं पर विचार।

कुलपति महोदय द्वारा डीन, ललित कला संकाय से अनुरोध किया गया कि वे संकाय की समस्त अनुशंसाओं का प्रस्तुतीकरण परिषद् के समक्ष प्रस्तुत करें। तत्पश्चात् डीन द्वारा संकाय की दिनांक 28 जून, 2017 को हुई बैठक की अनुशंसाओं का प्रस्तुतीकरण प्रस्तुत किया गया।

निश्चय कर अनुशंसा की कि ललित कला संकाय की अनुशंसाओं को स्वीकार किया जाता है।

(Encl.-7)

13. **डिजायन संकाय** की दिनांक 28 जून, 2017 की बैठक की अनुशंसाओं पर विचार।

कुलपति महोदय द्वारा डीन, डिजायन संकाय से अनुरोध किया गया कि वे संकाय की समस्त अनुशंसाओं का प्रस्तुतीकरण परिषद् के समक्ष प्रस्तुत करें। तत्पश्चात् डीन द्वारा संकाय की दिनांक 28 जून, 2017 को हुई बैठक की अनुशंसाओं का प्रस्तुतीकरण प्रस्तुत किया गया।

निश्चय कर अनुशंसा की कि डिजायन संकाय की अनुशंसाओं को स्वीकार किया जाता है।

(Encl.-8)

14. **प्रबन्धन संकाय** की दिनांक 29 जून, 2017 की बैठक की अनुशंसाओं पर विचार।

कुलपति महोदय द्वारा डीन, प्रबन्धन संकाय से अनुरोध किया गया कि वे संकाय की समस्त अनुशंसाओं का प्रस्तुतीकरण परिषद् के समक्ष प्रस्तुत करें। तत्पश्चात् डीन द्वारा संकाय की दिनांक 29 जून, 2017 को हुई बैठक की अनुशंसाओं का प्रस्तुतीकरण प्रस्तुत किया गया।

निश्चय कर अनुशंसा की कि प्रबन्धन संकाय की अनुशंसाओं को स्वीकार किया जाता है।

(Encl.-9)

15. **विधि संकाय** की दिनांक 30 जून, 2017 की बैठक की अनुशंसाओं पर विचार।

कुलपति महोदय द्वारा डीन, विधि संकाय से अनुरोध किया गया कि वे संकाय की समस्त अनुशंसाओं का प्रस्तुतीकरण परिषद् के समक्ष प्रस्तुत करें। तत्पश्चात् डीन द्वारा संकाय की दिनांक 30 जून, 2017 को हुई बैठक की अनुशंसाओं का प्रस्तुतीकरण प्रस्तुत किया गया।

निश्चय कर अनुशंसा की कि विधि संकाय की अनुशंसाओं को स्वीकार किया जाता है।

(Encl.-10)

16. **सामुदायिक कॉलेज** के पाठ्यक्रमों के लिए गठित समिति की दिनांक 10 दिसम्बर, 2016 की बैठक की अनुशंसाओं पर विचार।

कुलपति महोदय द्वारा सामुदायिक कॉलेज के पाठ्यक्रमों के लिए गठित समिति से अनुरोध किया गया कि वे समिति की समस्त अनुशंसाओं का प्रस्तुतीकरण परिषद् के समक्ष प्रस्तुत करें। तत्पश्चात् पाठ्यक्रमों के लिए गठित समिति की दिनांक 10 दिसम्बर, 2016 को हुई बैठक की अनुशंसाओं का प्रस्तुतीकरण प्रस्तुत किया गया।

निश्चय कर अनुशंसा की कि सामुदायिक कॉलेज के पाठ्यक्रमों के लिए गठित समिति की अनुशंसाओं को स्वीकार किया जाता है।

(Encl.-11)

17. विद्यापीठ के विभिन्न पाठ्यक्रमों हेतु कोड निर्धारण सम्बन्धी परियोजना पर की गई कार्यवाही की समीक्षा।

कुलपति महोदय द्वारा प्रो० प्रवीण ध्यानी जी से अनुरोध किया कि वे परिषद् के समक्ष कोड निर्धारण सम्बन्धी परियोजना का विवरण प्रस्तुत करे। तत्पश्चात् प्रो० प्रवीण ध्यानी जी ने पाठ्यक्रम कोड, कोडिंग संरचना एवं LTPC के बारे में संक्षिप्त प्रस्तुतीकरण प्रस्तुत किया गया। उन्होंने बताया कि शैक्षिक सत्र 2017-18 प्रथम वर्ष के लिए कोडिंग प्रक्रिया सम्पन्न कर दी गयी है।

निश्चय कर अनुशंसा की कि विद्यापीठ के विभिन्न पाठ्यक्रमों हेतु कोड निर्धारण सम्बन्धी परियोजना का अनुमोदन किया जाता है तथा इस सम्बन्ध में आगे विचार-विमर्श जारी रहेगा।

18. विद्यापीठ के विभिन्न पाठ्यक्रमों में चल रही 'Choice Based Credit System (CBCS)' प्रणाली की समीक्षा।

शैक्षिक परिषद् ने विद्यापीठ के विभिन्न पाठ्यक्रमों में चल रही 'Choice Based Credit System (CBCS)' प्रणाली पर विचार विमर्श किया।

निश्चय कर अनुशंसा की कि विद्यापीठ के विभिन्न पाठ्यक्रमों में चल रही 'Choice Based Credit System (CBCS)' प्रणाली की समीक्षा की गयी तथा इस दिशा में आगे विचार विमर्श जारी रहेगा।

19. शैक्षिक सत्र 2017-18 के लिए कुलपति महोदय द्वारा सर्टिफिकेट कोर्स (Android Application Development) प्रारम्भ किये जाने सम्बन्धी आदेशों को सूचना।

निश्चय कर अनुशंसा की कि सर्टिफिकेट कोर्स (Android Application Development) पाठ्यक्रम को अनुमोदित किये जाने सम्बन्धी आदेशों को अभिलिखित किया जाता है। अनुमोदित प्रस्ताव आगामी सत्रों के लिए भी प्रभावी रहेगा।

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Verified

Offg. Secretary
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