COURSE STRUCTURE, 6TH SEMESTER

COURSE STRUCTURE OF 6th SEMESTER (Computer Engineering)

Sl No	Code No.	Subject	Study Scheme (Contact hours/week)			Evaluation Scheme								Total Marks (Theory+Practical)	Credit
						Theory					Practical				
			L	T	P	ESE	Sessional (SS)			Pass(ESE+SS)	Practical Test (PT) #	Practical Assessment(PA) @	Pass (PT+PA)		
							TA	HA	Total (TA+HA)						
1	Hu-601	Industrial Management & Entrepreneurship	3			70	10	20	30	33/100				100	3
2	CO-601	Mobile Computing	3	1	3	70	10	20	30	33/100	25	25	17/50	150	5
3	CO-602	Crytography and Network Security	3		3	70	10	20	30	33/100	25	25	17/50	150	4
4	CO-603	Software Engineering	3			70	10	20	30	33/100				100	3
5	CO-611	Project & Seminar		1	6						100	50	50/150	150	3
6	CO-612	General Viva		2							50		17/50	50	2
7	CO-610	Professional Practice- IV	1		2						25	25	17/50	50	2
8		Elective (Any One)													
A	CO-604	Parallel Processing	3			70	10	20	30	33/100				100	3
B	CO-605	Graph Theory & Combinatorics	3			70	10	20	30	33/100				100	3
C	CO-606	Artificial Intelligence	3			70	10	20	30	33/100				100	3
		Total	17	3	14									850	25
			34												

1.Course Title :Industrial Management and Entrepreneurship

1. Course Code: **Hu – 601**

2. Semester: **VI**

3. **Aim of the Course:**
    1. To acquaint the students with managerial activities
    2. To provide introductory knowledge of Cost Accounting
    3. To introduce students with industrial legislation
    4. To explain the scope for self-employment
    5. To compare and contrast different forms of business organization
    6. To identify the opportunities to start a small scale industry

4. **Course Outcomes**:

On completion of the course on IME, students will be able to

- ➢ CO_1 =   explain managerial activities.
- ➢ CO_2 =   describe leadership qualities and decision making process.
- ➢ CO_3 =   state the elements of costs.
- ➢ CO_4 =   explain important industrial laws.
- ➢ CO_5 =   define different forms of business organisations
- ➢ CO_6 =   identify entrepreneurial abilities for self employment through small scale industries.

5. **Teaching Scheme (in hours)**

Lecture	Tutorial	Practical	Total
42 hrs	**3 hrs**	**--**	**45 hrs**

6. **Examination Scheme:**

Theory				Practical				Total Marks
Examination Full Marks	Sessional Full Marks	Total Marks	Pass Marks	Examination		Sessional		
70	30	100	33	--	--	--	--	100

7. **Detailed Course Content:**

Chapter No.	Chapter Title	Content	Intended Learning Outcomes	Duration (in hours)
				42 hrs
1.0	**Introduction to Management :**	i) Meaning and Concept ii) Functions of Management iii) Principles of Management	i) Explain functions and principles of management	3
2.0	**Leadership Decision Making & Communication :**	i) Definition of Leader ii) Functions of a leader iii) Decision making – Definition iv) Decision making process v) Communication – definition, importance & types	i) Develop leadership qualities ii) Demonstrate decision making abilities	4
3.0	**Introduction to Cost :**	i) Definition and classification of Cost ii) Elements of Cost iii) Break Even Analysis	i) State elements of costs ii) Explain Break Even Analysis	3

4.0	**Human Resource Management:**	i) Meaning of manpower planning ii) Recruitment and Selection procedure iii) Payment of wages – factors determining the wage iv) Methods of payment of wages – Time rate and Piece rate v) Labour Turnover – definition, its causes, impact and remedy	i) State selection procedure of employees ii) Distinguish Time rate and Piece rate system of wage payments iii) Explain causes and impact of labour turnover	5
5.0	**Industrial Legislation :**	i) Need of Industrial legislation ii) Indian Factories Act – 1948 – Definition of Factory, main provisions regarding health, Safety and Welfare of Workers iii) Industrial Dispute Act – 1947 – Definition of Industrial dispute, Machineries for settlement of Industrial dispute in India	i) Identify the needs and importance of industrial laws	5
6.0	**Production Management :**	i) Meaning of Production ii) Production Management – definition, objectives, functions and scope iii) Inventory Management, Basic idea	i) State the objectives and functions of Production management	3
7.0	**Marketing Management:**	i) Meaning and functions of marketing ii) e- Commerce iii) Channels of distribution iv) Wholesale and retail trade	i) state the functions of wholesalers and retailers	2

8.0	**Entrepreneur and Entrepreneurship:**	i) Definition of Entrepreneur and Entrepreneurship ii) Qualities required by an entrepreneur iii) Functions of an entrepreneur iv) Entrepreneurial motivation	i) State the qualities and functions of an entrepreneur	3
9.0	**Forms of Business Organization:**	i) Sole Trader – meaning, main features, merits and demerits ii) Partnership – definition, features, merits and demerits iii) Joint Stock Company – Definition, types, features, merits and demerits	i) Differentiate different forms of Business organization ii) compare and contrast features, merits and demerits of different business organizations.	5
10.0	**Micro and Small Enterprises:**	i) Definition of Micro & Small enterprises ii) Meaning and characteristics of Micro and Small enterprise iii) Scope of SSI with reference to self-employment iv) Procedure to start SSI – idea generation, SWOT analysis v) Selection of site for factories	i) Define micro and small enterprises ii) Explain the procedure to start a small enterprise	4
11.0	**Support to Entrepreneurs**	a) Institutional support: i) Introduction ii) Sources of information and required application forms to set up SSIs iii) Institutional support of various National & State level organizations – DICC, NSIC, IIE, MSME - DI, Industrial Estates	i) identify the supporting agencies to entrepreneurs ii) Explain the role of financial support	5

			organizations	
	b) Financial support: i) Role of Commercial banks, RRB, IDBI, ICICI, SIDBI, NEDFi, and State Financial Corporations ii) Special incentives and subsidies for Entrepreneurship Development in the North East			
	Class Test			3 hrs
	Total			**45 hrs**

(9) TABLE OF SPECIFICATIONS for Industrial Management & Entrepreneurship

Sl. No	Topic (a)	Time allotted in hours (b)	Percentage Weightage (c)	Knowledge	Compre- hension	Application	HA
1	Introduction to Management	3	7	2	3	0	0
2	Leadership & Decision Making	4	9.5	3	4	0	0
3	Introduction to Cost	3	7	3	2	0	0
4	Human Resource Management	5	12	6	2	0	0
5	Industrial Legislation	5	12	4	4	0	0
6	Production Management	3	7	3	2	0	0
7	Marketing	2	5	4	0	0	0

Sl No	Topic						
	Management						
8	Entrepreneur & Entrepreneurship	3	7	3	2	0	0
9	Forms of Business Organization	5	12	3	5	0	0
10	Micro & Small Enterprises	4	9.5	4	3	0	0
11	Support to Entrepreneurs	5	12	4	4	0	0
Total		42	100	39	31	0	70

K = Knowledge   C = Comprehension   A = Application   HA = Higher Than Application (Analysis, Synthesis, Evaluation) $C = \frac{b}{\Sigma b} \times 100$

10.Distribution of Marks:

DETAILED TABLE OF SPECIFICATIONS FOR IME

Sl. No	Topic	OBJECTIVE TYPE				SHORT ANSWER TYPE					ESSAY TYPE					Grand Total
		K	C	A	T	K	C	A	HA	T	K	C	A	HA	T	
1	Management	1	0	0	1	1	0	0	0	1	0	3	0	0	3	5
2	Leader &Decision	1	0	0	1	2	1	0	0	3	0	3	0	0	3	7
3	Cost	1	1	0	2	2	1	0	0	3	0	0	0	0	0	5
4	HRM	2	1	0	3	1	1	0	0	2	3	0	0	0	3	8
5	Laws	3	0	0	3	0	0	0	0	0	1	4	0	0	5	8
6	Product Manage	2	1	0	3	1	1	0	0	2	0	0	0	0	0	5
7	Market	2	0	0	2	2	0	0	0	2	0	0	0	0	0	4
8	Entrepreneurship	1	1	0	2	2	1	0	0	3	0	0	0	0	0	5

9	Forms of BO	2	1	0	3	0	0	0	0	0	1	4	0	0	5	8
10	MSME	2	0	0	2	0	0	0	0	0	2	3	0	0	5	7
11	Support to Entp.	3	0	0	3	1	0	0	0	1	0	4	0	0	4	8
	Total	20	5	0	25	12	5	0	0	17	7	21	0	0	28	70

K   =   Knowledge   C   =   Comprehension A = Application

HA =   Higher Than Application Higher than Application (Analysis, Synthesis, Evaluation)   Total

10. **Suggested implementation Strategies**: Modified syllabus may be implemented with effect from January, 2020 (Starting with the present batch (2018) of 2nd Semester students)

11. **Suggested learning Resource**:
   a. **Book list** :

Sl. No.	Title of Book	Name of Author(s)	Publisher
1	Industrial Management	S.C. Jain H.S. Bawa	DhanpatRai& Co. (P) Ltd. New Delhi-110006
2	Business Organisation and Entrepreneurship Development	S.S. Sarkar R.K. Sharma Sashi K. Gupta	Kalyani Publishers, New Delhi-110002
3	Entrepreneurial Development	S. S. Khanka	S. Chand & Co. Ltd. New Delhi-110055

4	Business Methods	R.K. Sharma Shashi K Gupta	Kalyani Publishers, New Delhi
5	Entrepreneurship Development and Management	Dr. R.K. Singhal	S.K. Kataria& Sons, New Delhi-110002
6	Business Administration & Management	Dr. S. C. Saksena	SahityaBhawan, Agra

b. List of Journals
c. Manuals
d. Others

Xxxxxxxxxxxxxxxxxxxx

2: Course Title- Mobile Computing

2:   **Course Code – CO-601**

3:   **Semester- 6th**

4:   **Aim of the Course :**

- To learn fundamentals of mobile computing and communication
- To learn Android programming .

5:   **Course Outcome :**

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

- Explain the basics of mobile computing.
- Analyse various modes of mobile communication.
- Explain the design basics in Android programming.
- Design simple Android applications.

6:   **Pre-requisites :**

- Fundamental idea of mobile communication

7:   **Teaching Scheme :**

Teaching Scheme			
L	T	P	Total hours per week
3	1	3	7

8:   **ExaminationScheme :**

	Theory (T)	Sessional (TS)	Practical (P)	Practical Sessional (PS)
Full Marks	70	30	25	25
Pass Marks	33		17	

9:   Detailed Course Content :

Unit	Topic/Sub-topic	Intended Learning Outcome (ILO)	Hours
1	**Introduction to Mobile Computing** 1.1 Concept of Mobile Communication 1.2 Different generations of wireless technology 1.3 Basics of cell, cluster and frequency reuse concept 1.4 Noise and its effects on mobile 1.5 Understanding GSM and CDMA 1.6 Basics of GSM architecture and services like voice call, SMS, MMS, LBS,VAS 1.7 Different modes used for Mobile Communication	• Explain the basics of the various technologies used in mobile communication • Differentiate between the technologies. • Identify the features and areas of implementation of the different technologies.	10
2	**Architecture and Design of Mobile Computing** 2.1 Architecture of Mobile Computing (3tier) 2.2 Design considerations for mobile computing 2.3 Characteristics of Mobile Communication 2.4 Application of Mobile Communication 2.5 Security Concern Related to Mobile Computing 2.6 Middleware and Gateway required for mobile Computing 2.7 Making Existing Application Mobile Enable	• Explain the architecture of mobile computing. • Determine the basic characteristics and considerations in mobile computing. • Describe the various components in mobile computing.	10
3	**Mobile Communication** 3.1 Mobile IP 3.2 Basic Mobile Computing Protocol 3.3 Mobile Communication via Satellite • Low orbit satellite • Medium orbit satellite • Geo stationary satellite 3.4 Satellite phones	• Define the basics of mobile communication. • Explain the process of satellite communication in the context of mobile communication.	6
4	**Introduction to Android** 4.1 Overview of Android	• Use the various utilities provided in android.	8

	4.2 What does Android run On – Android Internals? 4.3 Android for mobile apps development 4.4 Environment setup for Android apps Development 4.5 Framework - Android- SDK, Eclipse 4.6 Emulators – What is an Emulator / Android AVD 4.7 Android Emulation – Creation and set up 4.8 First Android Application	• Explain the basic structure of an android application. • Develop simple applications in android.	
5	**AndroidActivities andGUI DesignConcept** 5.1 Design criteria for Android Application : Hardware Design Consideration, Design Demands For Android application, Intent, Activity, Activity Lifecycle and Manifest 5.2 Creating Application and new Activities 5.3 Simple UI - Layouts and Layout properties : Introduction to Android UI Design, Introducing Layouts 5.4 XML Introduction to GUI objects viz.: Push Button , Text / Labels ,Edit Text, Toggle Button , Padding	• Define the basic principles of designing Android application. • Explain the concepts related to UI design. • Develop basic knowledge on GUI objects. • Apply the concepts in developing applications.	8
	Internal Assessment		3

Interpersonal Skills :

- Design applications
- Develop applications

Motor Skills :

- Proper handling of hardware.

Practical Exercises :

I. Installation and setup of java development kit(JDK),setup android SDK, setup eclipse IDE, setup android development tools (ADT) plugins, create android virtual device.
II. Create "Hello World" application. That will display "Hello World" in the middle of the screen using TextView Widget in the red color.
III. Create application for demonstration of android activity life cycle.
IV. Create Registration page to demonstration of Basic widgets available in android.

V. Create sample application with login module.(Check username and password) On successful login, Change TextView "Login Successful". And on failing login, alert user using Toast "Login fail".

VI. Create login application where you will have to validate username and passwords Till the username and password is not validated, login button should remain disabled.

VII. Create and Login application as above. Validate login data and display Error to user using setError () method.

VIII. Create an application for demonstration of Relative and Table Layout in android.

IX. Create an application for demonstration of Scroll view in android.

X. Create an application for demonstration of Explicitly Starting New Activity using Intent.:

XI. Create an application that will pass two number using TextView to the next screen , and on the next screen display sum of that number.

XII. Create spinner with strings taken from resource folder(res >> value folder). On changing spinner value, change background of screen.

10:   Distribution of Marks :

Unit	Topic	Type of Question			Total
		Objective	Short	Descriptive	Marks
1	Introduction to Mobile Computing	6	3	7	16
2	Architecture and Design of Mobile Computing	6	3	7	16
3	Mobile Communication	3	3	4	10
4	Introduction to Android	5	3	5	13
5	Android Activities and GUI Design Concept	5	3	7	15
		25	15	30	70

11:   Table of Specification:

Unit	Topic (a)	Time allotted in hours (b)	Percentage Weightage (c)	K	C	A	HA
1	Introduction to Mobile Computing	10	24	√	√		
2	Architecture and Design of Mobile Computing	10	24	√	√	√	
3	Mobile Communication	06	14	√	√		
4	Introduction to Android	08	19	√	√	√	
5	Android Activities and GUI Design Concept	08	19	√	√	√	
Total		42	100				

K = Knowledge   C = Comprehension A = Application

HA = Higher Than Application (Analysis, Synthesis, Evaluation) $c = b / \sum b * 100$

Detailed table of Specification

Unit	Topic	Objective				Short					Descriptive				
		K	C	A	T	K	C	A	HA	T	K	C	A	HA	T
1	**Introduction to Mobile Computing**	6			6		3			3	2	5			7
2	**Architecture and Design of Mobile Computing**	4	2		6	3				3		2	5		7
3	**Mobile Communication**	3			3	3				3		4			4
4	**Introduction to Android**	5			5	3							5		5
5	**Android Activities and GUI Design Concept**	5			5	3				3			7		10

K =Knowledge, C =Comprehension , A =Application, HA =Higher Than Application, T = Total

12:   Suggested Implementation Strategies :

i) Concepts should be introduced in classroom input sessions and by giving demonstrationthrough projector.

ii) More focus should be given on practical work which will be carried out in laboratorysessions. If possible some theory sessions may be conducted in labs so that theory andpractice can go hand in hand.

iii) Group Discussion and presentation of related websites should be arranged.

iv) Students should be encouraged to use their creativity during practical sessions and letthem struggle to learn on their own with faculty present to help the students when they are stuck.

13:   Suggested Learning Resources :

1: Building Android Apps ,IN EASY STEPS, McGraw-Hill Education.

2: Professional Android 2 Application Development, Reto Meier, Wiley India Pvt Ltd.

3: Beginning Android, Mark L Murphy, Wiley India Pvt Ltd.

4: Pro Android ,Sayed Y Hashimi and SatyaKomatineni, Wiley India Pvt Ltd.

3: Course Title - Cryptography and Network Security

2: **Course Code –CO-602**

3: **Semester- 6th**

4. **Aim:**

- Understand the basic concept of Cryptography and Network Security, their mathematical models, various types of ciphers,DES,AES, Message Authentication, Digital Signature,Encrypt and decrypt messages using block ciphers.

- Network security,virus,worms and firewall.

- Identify and classify computer and security threats and develop a security model to prevent, detect and recover from attacks

5: **Course Outcome:** By the end of this course, students will be able to:

- Explain concepts related to applied cryptography, including plaintext, ciphertext, symmetric cryptography, asymmetric cryptography, and digital signatures.

- Explain the theory behind the security of different cryptographic algorithms.

- Explain common network vulnerabilities and attacks, defence mechanisms against network attacks, and cryptographic protection mechanisms.
- Outline the requirements and mechanisms for identification and authentication.Identify the possible threats to each mechanism and ways to protect against these.

6: **Pre-requisite:**
- Knowledge on computer system security issues
- Basic idea of security software.

7: **Teaching Scheme:**

Teaching Scheme			
L	T	P	Total Hours per week
3	-	3	6

8:   ExaminationScheme:

	Theory (T)	Sessional (TS)	Practical (P)	Practical Sessional (PS)
Full Marks	70	30	25	25
Pass Marks	33		17	

9:   Detailed Course Content:

Unit	Topics/Sub-Topics	Intended Learning Outcomes	Hours
1	**Introduction:** 1.1 The need for security 1.2 Principles of Security – confidentiality, integrity, authentication, non-repudiation, access control and availability 1.3 Types of Attacks – passive and active attacks, Programs that attack-Virus,worm, Trojan horse, Applets and ActiveX control, Cookies, Specific Attacks–Spoofing and Sniffing(snooping), Phishing, Pharming.	37. Explain the need for security. 38. Define the principles/goals of security. 39. Discuss different types of attack. 40. Explain the working principles of virus, worms, Trojan horse and Cookies. 41. Discuss the concepts of phishing and pharming.	4
2	**Cryptography: Concept and Techniques** 2.1 Introduction 2.2 Plain Text and Cipher Text 2.3 Substitution Technique – Caesar Cipher, Mono-alphabetic Cipher,Homophonic Substitution Cipher, Polygram Substitution Cipher, Polyalphabetic Substitution Cipher, Playfair Cipher, Hill Cipher. 2.4 Transposition technique – Rail Fence Technique, Simple columnar Transposition Technique, Vernam Cipher. 2.5 Encryption and Decryption. 2.6 Symmetric and Asymmetric Key Cryptography. 2.7 Steganography.	42. Define the terms - cryptography, cryptographic system(cipher), cryptology, cryptanalysis, plain text and cipher text, encryption, decryption, steganography, symmetric key cryptography and asymmetric key cryptography. 43. Discuss the two categories of traditional ciphers: Substitution ciphers and transposition ciphers. 44. Explain the	7

		categories of cryptanalysis used to break the symmetric cipher.	
3	**Symmetric Key Algorithm:** 3.1 Introduction 3.2 Algorithm types and modes (ECB,CBC,CFB,OFB,CTR) 3.3 An overview of Symmetric Key Cryptography 3.4 Data Encryption Standard (DES) 3.5 Advanced Encryption Standards (AES)	45. Define basic structure of DES/AES. 46. Explain the concept of algorithm types– stream and block ciphers. 47. Discuss five modes of operation designed to be used with modern block ciphers. 48. Discuss the basic principles and main features of AES and DES.	10
4	**Asymmetric Key Algorithm:** 4.1 Introduction 4.2 Brief history of Asymmetric Key Cryptography 4.3 An overview of Asymmetric Key Cryptography 4.4 The RSA algorithm 4.5 Symmetric and Asymmetric Key Cryptography together. 4.6 Digital Signature, Message Digest, MD5, Secure Hash Algorithm(SHA), Hash-based Message Authentication Code(HMAC)	49. Distinguish between symmetric key and asymmetric key cryptography. 50. Discuss RSA algorithm 51. Define message authentication, message digest, message integrity, MAC and HMAC. 52. Explain the concept of digital signature and some of its applications. 53. Discuss the structure of SHA-512	12
5	**Authentication**	54. Explain the need	5

	5.1 Authentication Basics 5.2 Password 5.3 Authentication Tokens 5.4 Public Key infrastructures 5.5 Certification authorities and key distribution centres 5.6 Kerberos	for a Key distribution centre (KDC) and certification authorities (CA). 55. Introduce the idea of a Public Key Infrastructure (PKI) and explain some of its duties. 56. Describe Kerberos as a KDC and an authentication protocol.	
6	**Firewall** 6.1 Introduction 6.2 Firewall Characteristics 6.3 Capabilities and limitations of firewalls 6.4 Types of Firewall 6.5 Firewall Configuration 6.6 Trusted system 6.7 Virtual Private Networks	57. Define firewall, trusted system and Virtual Private Network (VPN). 58. Discuss different types of Firewall stating their strengths and limitations. 59. Explain various configurations of firewall.	**4**
	Internal Assessment		**3**

Intellectual Skill:
- will be able compare and realize different cryptological algorithms andanalyse the network security thread.

Motor Skill
- Handle computer systems

Lab Exercises :

I.   Write a program that can encrypt and decrypt using the general Caesar cipher.

II.   Write a Java program to perform encryption and decryption using the following algorithms:
- Caesar Cipher
- Rail Fence Technique
- Simple Transposition Technique

III.   Implement the Playfair cipher in the Java programming language
IV.   Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as on of the parties (Alice) and the JavaScript application as the other party (Bob)
V.   Consider a plain text message I AM A HACKER. Encrypt it with the help of the following algorithm:
   (a) Replace each alphabet with its equivalent 7-bit ASCII code.
   (b) Add a 0 bit as the leftmost bit to make each of the above bit patterns 8 position long.
   (c) Swap the first four bits with the last four bits for each alphabet
   (d) Write the hexadecimal equivalent of every four bits

   Write a C program to perform the task of the above exercise.

VI.   Write a C program to implement the DES algorithm logic.
VII.   Write a C program that calculates the message digest of a text using the MD5 algorithm.
VIII.   Write a JAVA program to implement the RSA algorithm.
IX.   Many programming languages allow the generation of random numbers. However, these numbers are not really random – in fact, they are predictable. Write a C program that generates a series of 10 random numbers. Repeat the same program execution many times and see how the random numbers are repeated(i.e. they are not random).
X.   Write a program in Java which performs a digital signature on a given text.
XI.   Study at least one real-life firewall product. Study its features with reference to the theory.
XII.   Try to download a free home firewall. Which of its features are annoying at times? Why?

10:   Distribution of Marks :

Unit	Topic/ Sub-Topic	Type of Question			Total Marks
		Objective	Short	Descriptive	
1	Introduction	3	1	5	9
2	Cryptography: Concept and Techniques	4	2	5	11
3	Symmetric Key Algorithm	5	4	5	14
4	Asymmetric Key Algorithm	7	4	5	16
5	Authentication	4	2	5	11
6	Firewall	2	2	5	9
		25	15	30	70

11:   Table of Specification

Unit	Topic/ Sub-Topic (a)	Time allotted in hours (b)	Percentage Weightage (c)	K	C	A	HA
1	Introduction	4	9	✓	✓	✓	
2	Cryptography: Concept and	7	17	✓	✓		

3	Symmetric Key Algorithm	10	24	✓	✓		✓
4	Asymmetric Key Algorithm	12	29	✓	✓		✓
5	Authentication	5	12	✓	✓	✓	
6	Firewall	4	9	✓	✓		
Total		Σ b = 42	100				

K =Knowledge   C=Comprehension   A=Application

HA= Higher Than Application(Analysis,Synthesis,Evaluation) c= (b/Σ b)x 100

Detailed Table of Specification

Unit	Topic/ Sub-Topic	Objective									Descriptive				
		K	C	A	T	K	C	A	HA	T	K	C	A	HA	T
1	Introduction	1	2		3	1				1		5			5
2	Cryptography: Concept	2	2		4		2			2			5		5
3	Symmetric Key Algorithm	2	3		5	1	3			4				5	5
4	Asymmetric Key	3	4		7	1	3			4				5	5
5	Authentication	2	2		4		2			2			5		5
6	Firewall	2			2		2			2		5			5
Total					25					15					30

K =Knowledge C=Comprehension A=ApplicationHA=Higher Than Application(Ana, Sys, Eva)

12:   **Suggested Implementation Strategies :**

13:   **Suggested Learning Resources :**

- Cryptography and Network Security – by AtulKahate, Tata McGraw Hill
- Cryptography and NetworkSecurity(Principles and Practices) – by William Stallings, PHI

4: Course Title – Software Engineering

2:   **Course Code –CO- 603**

3:   **Semester- 6th**

4:   **Aim of the course :**

- To learn about the various software development models
- To learn about the concepts in software project management.

5:   **Course Outcome :**

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

- Analyse the importance of software engineering
- Demonstrate the steps of software development process.
- Design software using structured analysis tools.
- Explain the basics of software testing
- Estimate effort and size of a software project.

6:     **Pre-requisite :**
- Basic concept of a software.

7:   **Teaching Scheme :**

Teaching Scheme			
L	T	P	Total Hours per week
3	-	-	3

8:   **ExaminationScheme :**

	Theory (T)	Sessional (TS)	Practical (P)	Practical Sessional (PS)
Full Marks	70	30	-	-
Pass Marks	33		-	

9:   Detailed Course Content :

Unit	Topics/Sub-topics	Intended Learning Outcome	Hours
1	**Introduction to Software Engineering** 1.1 The evolving role of software 1.2 Software crisis problems and causes 1.3 Software Engineering paradigm 1.4 Classic Life cycle 1.5 Prototyping life cycle 1.6 Spiral model 1.7 Generic view of software engineering	1. State the role of software engineering. 2. Explain the various software development process models	4
2	**Software requirement analysis** 2.1 Requirement Analysis fundamentals 2.2 Structured Analysis: Basic notation and its extension 2.3 Object oriented analysis and data modelling (ERD), process modelling	3. State the procedure of requirement analysis. 4. List the contents of specification document. 5. Explain the fundamental concepts in object oriented analysis. 6. Prepare ER-diagrams.	6
3.	**Software Design** 3.1 Evolution of software design and characteristics of a good design 3.2 Design Fundamentals: Abstraction, refinement, modularity and software architecture 3.3 Flow oriented design and object oriented design	7. State the important design considerations. 8. Distinguish between flow oriented and object oriented design.	5
4.	**Quality Assurance** 4.1 Software quality factor 4.2 Software quality assurance 4.3 SQA activities 4.4 Software reliability, errors and faults 4.5 Software reliability model	9. Define quality related concepts. 10. Discuss the procedure to implement quality assurance. 11. Identify the software reliability metrics.	3

5.	**Verification and Validation** 5.1 Introduction to concepts in software testing 5.2 Software testing strategies 5.3 Techniques of black-box and white-box testing	12. Define the basic concepts in software testing. 13. Differentiate between black box and white box testing. 14. Explain a few software testing strategies.	8
6.	**Software Evaluation and Documentation** 6.1 Software Evaluation Criteria 6.2 Need and Characteristics of a good document 6.3 Internal and External documentation	15. State the criteria for evaluating a software. 16. Explain the role of documentation in software engineering.	4
7.	**Software Project Management** 7.1 Basic concept of software project management process, objectives, scope, estimation, COCOMO model. 7.2 Project Planning. 7.3 Project scheduling, Gantt Chart, pert chart. 7.4 Managing people, project stuffing, group working, working environment. 7.5 Project monitoring, milestone, method of project monitoring. 7.6 Risk Analysis, tracking and control, version management.	17. State the objectives of project management. 18. Describe the project planning activities. 19. Estimate project duration and cost. 20. Explain the project monitoring activities. 21. Describe the risk analysis process.	12
	Internal Assessment		3

10:   Distribution of Marks :

Chapter No.	Chapter Title	Type of Question			Total Marks
		Objective	**Short**	**Descriptive**	
1	**Introduction to Software Engineering**	2	2	4	8
2	**Software requirement analysis**	3	2	5	10
3	**Software Design**	2	2	4	8
4	**Quality Assurance**	1	2	3	6
5	**Verification and Validation**	5	3	4	12
6	**Software Evaluation& Documentation**	3	2	3	8
7	**Software Project Management.**	9	2	7	18
	TOTAL	25	15	30	70

11: Table of Specification:

Unit	Topic (a)	Time allotted in hours (b)	Percentage of weightage (c)	K	C	A	HA
1	Introduction to Software Engineering	4	10%	✓			
2	Software requirement analysis	6	14%	✓	✓	✓	
3	Software Design	5	12%	✓	✓	✓	
4	Quality Assurance	3	7%	✓	✓		
5	Verification and Validation	8	19%	✓	✓	✓	
6	Software Evaluation & Documentation	4	10%	✓			
7	Software Project Management.	12	28%	✓			
	Total	∑b=42	100%				

K = Knowledge   C = Comprehension A = Application

HA = Higher Than Application (Analysis, Synthesis, Evaluation) $c = b/\sum b * 100$

Detailed Table of specification

Unit	Topic (a)	Objective K	Objective C	Objective A	Objective T	Short K	Short C	Short A	Short HA	Short T	Descriptive K	Descriptive C	Descriptive A	Descriptive HA	Descriptive T
1	Introduction to Software Engineering	2			2	2				2	4				4
2	Software requirement analysis			3	3		2			2	5				5
3	Software Design	2			2		2			2			4		4
4	Quality Assurance	1			1		2			2	3				3
5	Verification and Validation	3	1	1	5		3			3			4		4
6	Software Evaluation & Documentation	3			3	2				2	3				3
7	Software Project Management.	9			9	2				2	7				7
					25					15					30

K =Knowledge, C =Comprehension , A =Application, HA =Higher Than Application, T   =   Total

12:   Suggested Implementation Strategies :

i) Concepts in the topics are to be discussed in the light of software development.

ii) The topics relevant to project work are to be discussed in the light of project.

iii) The principles of software development are to be implemented while developing the project.

13:   **Suggested Learning Resources :**

1.   Software Engineering Beginners Approach by –Pressman –TMH
2.   Software Engineering –by PankajJalote
3.   Fundamentals of Software Engg –Carlo Ghezzi, Mehdi Jazayeri, & Dino Mandrioli –PHI
4.   Software Engineering –by Sommerville

5: Course Title- Parallel Processing

2: **Course Code –CO-604**

3: **Semester- 6th**

4: **Aim of the course:**

- To learn about parallel computing architecture
- To learn about vector processing
- To understand subject related algorithms

5: **Course Outcome:**

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

- State the scope, design and model of parallelism
- Explain the parallel computing architecture.
- Define the parallel algorithms.
- Analyse model and performance of parallel programs.

6: **Pre-requisites :**
- Knowledge of distributed computing

7: **Teaching Scheme:**

Teaching Scheme			
L	T	P	C
3	-	-	3

8: **Examination Scheme:**

	Theory (T)	Sessional (TS)	Practical (P)	Practical Sessional (PS)
Full Marks	70	30	-	-
Pass Marks	33		-	

9:   Detailed Course Content:

Unit	Topics/Sub-topics	Intended Learning Outcome	Hours
1	**Introduction to Parallel Processing :** 1.1 Evolution of Computer System 1.2 Parallelism in Uniprocessor System 1.3 Parallel Computer Structure 1.4 Architectural Classification Scheme 1.5 Parallel Processing Application	31. Familiarize with the different types of computer. 32. Explain about Parallel processing application.	10
2	**Memory System Design :** 2.1 Hierarchical Memory Structure 2.1.1 Memory Hierarchy 2.1.2 Addressing Scheme for Main Memory 2.2 Virtual Memory System 2.2.1 The Concept of Virtual Memory 2.2.2 Paged Memory System 2.2.3 Segmented Memory System 2.3 Cache Memories and Management 2.3.1 Characteristics of Cache Memories 2.3.2 Cache Memory Organisation	33. Explain about memory hierarchy. 34. Explain of addressing scheme of memory. 35. Define the concept of virtual memory such as paged and segmented memory system. 36. Explain characteristics of cache memory and its organization.	8
3	**Principles of Pipelining and Vector Processing :** 3.1 Pipelining: An Overlapped Parallelism 3.1.1 Principles of Linear Pipelining 3.1.2 Classification of Pipeline Processor 3.2 Instruction and Arithmetic Pipelines 3.2.1 Design of Pipelined	37. Describe overlapped parallelism. 38. Explain about linear pipelining and classification different types of pipeline processor. 39. Designing of instruction and arithmetic pipeline.	10

	Instruction Units 3.2.2 Arithmetic Pipelines Design Examples 3.3 Vector Processing Requirements 3.2.1 Characteristic of Vector Processing 3.2.2 Pipelined Vector Processing Methods	40. Describe vector processing ,its characteristic and pipelined processing.	
4	**Structures and Algorithms for Array Processors :** 4.1 SIMD Array Processor 4.1.1 SIMD Computer Organisation 4.1.2 Inner-PE Communication 4.2 SIMD Interconnection Network 4.2.1 Static versus Dynamic Networks 4.2.2 Mesh-Connected Illiac Network 4.2.3 Cube Interconnection Network 4.2.4 Barrel Shifter and Data Manipulator 4.2.5 Shuffle-Exchange and Omega Networks 4.3 Parallel Algorithms for Array Processors 4.3.1 SIMD Matrix Multiplication 4.3.2 Parallel sorting on Array Processor	41. Explain about different structures of array processor. 42. Describe about SIMD computer , inner –PE communication. 43. Explain about different SIMD interconnection networks. 44. Identify the difference of static and dynamic networks. 45. Explain about different networks. 46. Explain about parallel algorithms , SIMD multiplication, sorting on Array processor.	6
	Internal Assessment		3

10:   Distribution of Marks :

Unit	Topics	Type of Question			Total Marks
		Objective	Short	Descriptive	
1	Introduction to Parallel Processing Structures and	5	3	5	13
2	Memory System Design	5	6	8	19
3	Principles of Pipelining and Vector Processing	8	3	8	19
4	Algorithms for Array Processors	7	3	9	19
		25	15	30	70

11: Table of Specification :

Unit	Topic (a)	Objective				Short					Descriptive				
		K	C	A	T	K	C	A	HA	T	K	C	A	HA	T
1	Introduction to Parallel Processing.	5			5	3				3	5				5
2	Memory System Design		5		5		6			6		8			8
3	Principles of Pipelining and Vector Processing.	8			8	3				3	8				8
4	Structures and Algorithms for Array Processors.			7	7			3		3			9		9

K =   Knowledge   C = Comprehension   A =Application

HA = Higher Than   Application (Analysis, Synthesis, Evaluation) $c = \frac{b}{\Sigma b} * 100$

Detailed Table of specification :

Units	Topics (a)	Time allotted in hours (b)	Percentage of weightage (c)	K	C	A	HA
1	Introduction to Parallel Processing.	10	24%	✓			
2	Memory System Design	12	28%		✓		
3	Principles of Pipelining and Vector Processing.	10	24%	✓			
4	Structures and Algorithms for Array Processors.	10	24%			✓	
	Total	∑b=42					

K   = Knowledge C   = Comprehension   A = Application HA = Higher Than Application T   =   Total

12:   **Suggested Implementation Strategies :**

13:   **Suggested Learning Resources :**

1.   Computer Architecture and Parallel Processing–by Kai Hwang and F. A. Briggs - McGrawHill
2.   Advanced Computer Architecture – by Kai Hwang -
3.   Computer Architecture &Organisation – by Hayes - McGrawHill

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6:   Course Title - ARTIFICIAL INTELLIGENCE

2:   **Course Code – CO – 606 (Elective)**

3:   **Semester- 6th**

4:   **Aim of the Course :**

- To learn basics of AI
- To learn different forms of knowledge representation and search techniques
- To understand design of Expert Systems

5:   **Course Outcome :**

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

- Explain the basics of Intelligent systems
- Develop basic idea on expert systems
- Write small programs in Prolog

6:   **Pre-requisites :**

- Fundamental knowledge about software systems.

7:   **Teaching Scheme :**

Teaching Scheme			
L	T	P	Total hours per week
3	--	--	3

8:   **ExaminationScheme :**

	Theory (T)	Sessional (TS)	Practical (P)	Practical Sessional (PS)
Full Marks	70	30	-	-
Pass Marks	33		-	

9:   **Detailed Course Content :**

Unit	Topic/Sub-topic	Intended Learning Outcome (ILO)	Hours
1	**Introduction to Artificial Intelligence** 1.1 History and progress of AI 1.2 Simulation and AI 1.3 Intelligent Systems	1. State the history and evolution of AI 2. Familiarise the human intelligence components	5

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		that are simulated in AI systems.	
		a.	
2	**Knowledge representation** 2.1 Introduction 2.2 Propositional Calculus 2.3 Predicate Calculus 2.4 Rule based knowledge representation 2.5Knowledge representation issues.	3. State the various ways of representing information of the real world. 4. Define the knowledge representation issues 5. Apply the knowledge representation basics in solving simple real life problems.	8
		a.	
3	**Heuristic Search** 3.1 Problem solving technique 3.2 Heuristic Search 3.3 Techniques for heuristic search	6. Define the concept of heuristic search in context of AI 7. Explain few search techniques 8. Apply the search technique and develop very simple programs.	4
		a.	
4	**Learning** 4.1 Definition and mechanisms of learning 4.2 Candidate Elimination Algorithm 4.3 Discovery, Analogy, Formal Learning Theory 4.4 Neural net learning and Genetic learning.	9. Define the various mechanism of learning in AI. 10. Identify the differences in various learning theory 11. Differentiate between neural net and genetic learning.	10
		a.	
5	**Expert Systems** 5.1 Introduction and general concepts of ES 5.2 Elements and Applications of ES 5.3 Production systems 5.4 Markov and Rete Algorithm	12. Identify the various components of expert systems. 13. Explain the functions of the components of expert systems 14. Define the basic concept of production systems.	10
		a.	
6	**Basics of Prolog** 6.1 Introduction to Prolog programming 6.2 Terminologies and variables 6.3 Control structures. 6.4 Matching, cuts and recursion.	15. Write simple programs in Prolog	5

	Internal Assessment		3

10:   Distribution of Marks :

Unit	Topic	Type of Question			Total Marks
		Objective	Short	Descriptive	
1	Introduction to Artificial Intelligence	4		4	8
2	Knowledge representation	5	3	6	14
3	Heuristic Search	1	2	3	6
4	Learning	6	4	6	16
5	Expert Systems	6	4	6	16
6	Basics of Prolog	3	2	5	10
		25	15	30	70

11: Table of Specification :

Unit	Topic (a)	Time allotted in hours (b)	Percentage Weightage (c)	K	C	A	HA
1	Introduction to Artificial Intelligence	5	12	√			
2	Knowledge representation	8	19	√	√	√	
3	Heuristic Search	4	9	√	√	√	
4	Learning	10	24	√	√		
5	Expert Systems	10	24	√	√		
6	Basics of Prolog	5	12	√	√	√	
Total		42	100				

K =   Knowledge   C   =   Comprehension A   =   Application

HA =   Higher Than Application (Analysis, Synthesis, Evaluation)   c $= b/\sum b * 100$

Unit	Topic	Objective				Short					Descriptive				
		K	C	A	T	K	C	A	HA	T	K	C	A	HA	T
1	Introduction to Artificial Intelligence	4			4						4				4
2	Knowledge representation	3	2		5		3			3		2	4		6
3	Heuristic Search		1		1	2				2			3		3
4	Learning	4	2		6	1	3			4	2	4			6
5	Expert Systems	3	3		6	3	1			4	4	2			6
6	Basics of Prolog	2	1		3		2			2			5		5

K =Knowledge,   C =Comprehension , A =Application, HA =Higher Than Application, T   =   Total

12:   Suggested Implementation Strategies :

1: Students are to be given exercises to develop logical thinking.

2:   Though there are no assigned practical classes, demonstration of prolog programming can be done in the lab to get better concepts in programming.

13:   Suggested Learning Resources :

1: Artificial Intelligence by Elaine Rich, Kevin Knight, andShivshankarB. Nair, 3rd edition, McGraw-Hill Publishing

2: Expert Systems by Joseph C. Giarratano and Gary D. Riley, 4th edition

3: Artificial Intelligence by SarojKaushik, Cengage Learning.

4: An Introduction to Logic Programming Through Prolog, J. M. Spivey, Prentice Hall.

7:   Course Title -   Graph Theory & Combinatorics

2:   **Course Code –CO- 605**

3:   **Semester- 6th**

4:   **Aim of the Course:**

- To learn fundamental concepts related to graph and its evaluation.
- To understand different types of graph and their applications.
- To learn related theorems and their applications.

5:   **Course Outcome :**

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

- Define the relevant vocabulary from graph theory and combinatorics
- Explain important theorems in the subject
- Solve problems related to theorems

6:   **Pre-requisites :**

- Knowledge about subject related terms.

7:   **Teaching Scheme :**

Teaching Scheme			
L	T	P	Total hours per week
3	-	-	3

8:   **ExaminationScheme :**

	Theory (T)	Sessional (TS)	Practical (P)	Practical Sessional (PS)
Full Marks	70	30	-	-
Pass Marks	33		-	

9:   **Detailed Course Content :**

Unit	Topics/Sub-topics	Intended Learning Outcome	Hours
1	1.0 **Basic Concepts**	1. 1.Define precise and accurate definitions of	6

	1.1 Graphs & sub graphs 1.2 Isomorphism & Degrees 1.3 Walks & connected graphs 1.4 Cycles in graphs 1.5 Cut vertices & cut edges 1.6 Matrix representation of graphs	objects in graph theory 2. 2. Use mathematical definitions to identify and construct examples.	
2	**Evaluation of Graphs** 2.1 Eulerian graphs 2.2 Hamiltonian Graphs 2.3 Weighted Graphs	3. 1. Determine different types of Graph, its underlying mathematical concepts	5
3	**Bipartite Graphs** 3.1 Bipartite Graphs 3.2 Perfect matching –the marriage problem 3.3 Trees 3.4 Spanning Trees	4. 1. Model real world problem using different types of graphs.	6
4	**Planner Graphs** 4.1 Definitions 4.2 Euler Formula 4.3 Characterization of planner graphs – Kuratowaski's Theorem (without proof) 4.4 Colouring of planner graphs (vertex colouring only)	5. 1. Solve real world problem using colouring concept of graph theory	5
5	**Directed Graphs** 5.1 Representation 5.2 Connectivity in Digraphs 5.3 Strong Orientation of Graphs 5.4 Eulerian Digraphs 5.5 Tournaments	6. 1. Solve real world problem using concept of connectivity , orientations, Tournaments of graph	6
6	**Graphs Algorithms** 6.1 Depth-First & Breadth-First Algorithms 6.2 Shortest path Algorithms 6.3 Minimal Spanning Trees	7. 1. Implement standard algorithms of graph theory to evaluate reliability of networks.	6
7	**Combinatorics**	8. Formulate and analyze real world problems in	8

	7.1 Counting Principles
	  7.1.1 Sum & product rules
	  7.1.2 Counting Functions
	  7.1.3 Binomial & multinomial theorems
	  7.1.4 Inclusion & exclusion principles
	  7.1.5 MarriageProblem Revisited
	7.2 Ramsey Theory
	  7.2.1 The Pigeonhole Principles
	  7.2.2 Ramsey's theorem(without proof)
	  7.2.3 Examples of Ramsey's theorem
	7.3 Difference Equation
	  7.3.1 Difference operator
	  7.3.2 Linear difference equations
	  7.3.3 First order Linear Equations
	  7.3.4 Linear equation with constant Coefficient
	  7.3.5 Systems of Difference Equations
	7.4 Block Design & Error Correcting Codes
		framework of combinatorial optimization and graph models.
		
		9. 2. Manipulate techniques in coding theory for error minimization	

	Internal Assessment		**3**

10:   Distribution of Marks :

Unit	Topics	Type of Question			Total
		Objective	**Short**	**Descriptive**	**Marks**
1	Basic Concepts	4	3	3	10
2	Evaluation of Graphs	3	2	3	8
3	Bipartite Graphs	4	2	4	10
4	Planner Graphs	2	3	3	8
5	Directed Graphs	4	3	3	10
6	Graphs Algorithms	4		6	10
7	Combinatorics	4	2	8	14
		25	15	30	70

11: Table of Specification :

Unit	Topic (a)	Time allotted in hours (b)	Percentage Weightage (c)	K	C	A	HA
1	Basic Concepts	6	14	√		√	
2	Evaluation of Graphs	5	12	√		√	
3	Bipartite Graphs	6	14	√		√	
4	Planner Graphs	5	12	√		√	
5	Directed Graphs	6	14	√		√	
6	Graphs Algorithms	6	14	√		√	
7	Combinatorics	8	20	√		√	
Total		Σ b=42	100				

K = Knowledge   C = Comprehension   A = Application

HA = Higher Than Application (Analysis, Synthesis, Evaluation)

$$c = \frac{b}{\Sigma b} \times 100$$

Detailed Table Of Specifications

Unit	Topic	Objective				Short					Descriptive				
		K	C	A	T	K	C	A	HA	T	K	C	A	HA	T
1	Basic Concepts	4			4	1		2		3			3		3
2	Evaluation of Graphs			3	3			2		2			3		3
3	Bipartite Graphs	4			4			2		2	2		2		4

4	Planner Graphs	2		2	1	2		3	1	2	3
5	Directed Graphs	4		4	1	2		3		3	3
6	Graphs Algorithms	4		4					2	4	6
7	Combinatorics	4		4	2			2	4	4	8

K = Knowledge C = Comprehension A =Application HA = Higher than Application T   =   Total

12:   Suggested Implementation Strategies :

13:   Suggested Learning Resources :

1. Graph Theory & Application by –N Deo –Prentice Hall
2. Graph Theory by –F. Harary -Narosa Publishing House
3. Introduction Combinatorial Mathematics –by C.L Liu
4. Discrete Mathematics for Computer Scientists –by J.K Truss –Addison -Wesley

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8:   Course Title – Professional Practice - IV

2:   **Course Code – CO- 610**

3:   **Semester- 6th**

4:   **Aim of the Course :**

- To introduce to the recent developments in the areas covered in this semester.
- To improve communication skill.

5:   **Course Outcome :**

On completion of the course students will be able to :

- Express themselves in discussions.
- Identify the recent developments in relevant areas.
- Develop report writing skill.
- Develop analytical skill

6:   **Pre-requisites :**

- Basic knowledge in the subjects covered in the semester.

7:   **Teaching Scheme :**

Teaching Scheme			
L	T	P	Total hours per week
1	-	2	3

8:   **ExaminationScheme :**

	Theory (T)	Sessional (TS)	Practical (P)	Practical Sessional (PS)
Full Marks	-	-	25	25
Pass Marks	-		17	

9: **Detailed Course Content :**

Unit	Exercises/Activities	Hours
1	**Industrial Visits** : Structured industrial visits be arranged and report of the same shall be submitted by the individual student, to form a part of the team work. The industrial visits may be arranged in the following areas/ industries. Any two visits may be considered - Software Development centre - Computer Maintenance centre - Educational organization using advanced technology - Data warehouse - Industry related to computer related advance technology.	4
2	**Guest Lectures** Experts/ Professionals from Field/Industry are to be invited for talks on the listed topics and similar areas. A brief report is to be submitted on the guest lectures by each student as a part of assignment (Any two) - Hacking - Human Resource Management (HRM) - Entrepreneurship - AI - Mobile Computing - Internet of Things - Enterprise Resource Planning (ERP)	4
3	**Group Discussion**: Students are to form groups of five to seven students and discuss on a chosen topic listed below. A brief report on the same is to be prepared and submitted by each student including the points discussed during the discussion providing a concluding remark. Any two topics for group discussions may be selected by faculty members from the suggested topics – - APP development - Recent development in Computer Architecture - Big Data - Human Computer Interaction - Image Processing	4
4	**Seminar** Seminar topic should be related to the subjects from third, fourth or fifth semester subjects or from guest lectures. Students shall submit a	4

		report of at least 10 pages and deliver a seminar (presentation time – 10 minutes for a group of 2 students)	
5		**Mini Project: (In A Group Of 4-5 Students)** A mini project on the listed area is encouraged to develop confidence in building software systems. The mini projects should exhibit the basic functionalities of the system selected for project. • Web page development • Very small information system • Use of different programming languages. • Very small multimedia projects	10
6		**Student Activities** The students in groups of will perform **any two** of the following activities (other similar activities may be considered) and write a report on the activity performed. • Social service • Interview of successful entrepreneurs in the field of Information Technology • Survey on recent emphasis by govt. aided scheme in the area of Information Technology • Survey of Computer virus of nearby areas.	4

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