2.3.2 Basic information of each course/module

<table>
<tr><td>1</td><td colspan="6">Name of Course/Module :OBJECT ORIENTED PROGRAMMING</td></tr>
<tr><td>2</td><td colspan="6">Course Code: MCS 111</td></tr>
<tr><td>3</td><td colspan="6">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="6">Rationale for the inclusion of the course /module in the programme:
This module will help the students to understand the concept of object oriented programming. This course is essential for the collection of individual units or objects for receiving messages, processing data and sending messages to other objects.</td></tr>
<tr><td>5</td><td colspan="6">Semester and Year offered: Year 1 Semester 1</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>O</td></tr>
<tr><td></td><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>35</td><td>2</td><td>25</td><td>6</td><td>62</td><td>130</td></tr>
<tr><td>7</td><td colspan="6">Credit Value: 3</td></tr>
<tr><td>8</td><td colspan="6">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="6">Course Learning Outcomes:
On completion of this course students will be able to:
• Describe the basic principles of object oriented Programming.
• Summarize the full range of considerations in the Data structures as Group Assignment.
• Compare the key trade-offs between multiple approaches.</td></tr>
<tr><td>10</td><td colspan="6">Transferable Skills:
• Communication Skills
• Information Management and Lifelong Learning
• Critical Thinking and Problem Solving Skills</td></tr>
<tr><td>11</td><td colspan="6">Teaching –learning and assessment strategy
• Lectures
• Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer</td></tr>
<tr><td>12</td><td colspan="6">Synopsis:
This course is designed to progressively broaden and deepen the knowledge and program skills demonstrated by the student at a range of levels on their way through OOPS Concepts.</td></tr>
<tr><td>13</td><td colspan="6">Mode of Delivery:
Lectures, Tutorials, Practical.</td></tr>
</table>

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
x1	**Introduction to OOP:** • Introduction to OO: Classes and Objects • Comparison between structured programming and OOP • Declaring objects • Member data and functions • Encapsulation • Constructor, destructor and finalize() method • Chain of constructor • Invoking base class constructor • Objects and arrays • "this" keyword • Wrapper classes • Objects as parameter	7	-	5	-	12	24
2	**Inheritance and Polymorhism:** • Super class, sub class, inheritance and member access • Types of inheritance • Extends and super keyword • Overriding methods • The object class • Final classes and methods • Abstract classes and methods • Creating and using interface • Method overloading • Upcasting and downcasting • Object equivalence	8	-	5	-	13	26

	3.	**String and stringbuffer Class:** • String Vs String Buffer • Accessor methods • Immutable string • Converting objects to string • Strings and the Java compiler	3	-	3	-	6	12
	4	**Exception Handling:** • Errors and exceptions • Why we need to deal with exception • Life cycle of exception • Checked and unchecked exception • Exception hierarchy • Catching and handling exceptions • Try, catch and finally block • Throwing the exception • Exception class • Creating our own exception	8	-	4	-	12	24
	5.	**Input and Output Streams:** • Representing and managing file paths • I/O class hierarchy • Byte streams and character streams • Exception handling in Java I/O • Java file I/O classes • Object serialization	3	-	3	-	6	12
	6.	**Java Collections:** • Javacollection and generic • Iterating collection • List, ArrayList, LinkedList, Set, HashSet, Map • Type safety in java collection • Type wildcards	3	-	5	-	8	16

	7.	**Design Pattern:** • Introduction to design pattern • Singleton, factory, abstract factory • Adapter • Composite • Decorator • Chain of responsibility • Observer	3	2	-	-	5	10
		Total	35	2	25	-	62	124

16. **Main references supporting the course:**

- *Java : The Complete Reference*, 7th edition, Herbert Schildt
- *Java How to Program*, 9th edition, Paul Deitel, Harvey Deitel

<table>
<tr><td>1</td><td colspan="7">Name of Course/Module :DESIGN & ANALYSIS ALGORITHMS</td></tr>
<tr><td>2</td><td colspan="7">Course Code: MCS 112</td></tr>
<tr><td>3</td><td colspan="7">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="7">Rationale for the inclusion of the course /module in the programme:
This course is designed to provide theoretical and practical backbone on the basic and in depth understanding about the fundamentals of the analysis of algorithm efficiency.</td></tr>
<tr><td>5</td><td colspan="7">Semester and Year offered: Year 1 Semester 1</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>O</td></tr>
<tr><td></td><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>27</td><td>-</td><td>35</td><td>6</td><td>62</td><td>130</td></tr>
<tr><td>7</td><td colspan="7">Credit Value: 3</td></tr>
<tr><td>8</td><td colspan="7">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="7">Course Learning Outcomes:
On completion of this course students will be able to:
• Argue the correctness of algorithms using inductive proofs and invariants.
• Analyze worst-case running times of algorithms using asymptotic analysis.
• Demonstrate a familiarity with major algorithms and data structures.</td></tr>
<tr><td>10</td><td colspan="7">Transferable Skills:
• Information Management and Lifelong Learning
• Critical Thinking and Problem Solving Skills</td></tr>
<tr><td>11</td><td colspan="7">Teaching –learning and assessment strategy
• Lectures
• Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer</td></tr>
<tr><td>12</td><td colspan="7">Synopsis:
The goal of this course is to provide a solid background in the design and analysis of the major classes of algorithms. It includes fundamentals logic for games and puzzles, Divide and conquer method, greedy method and dynamic programming I.</td></tr>
<tr><td>13</td><td colspan="7">Mode of Delivery:
Lectures, Tutorials, Practical.</td></tr>
</table>

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Fundamentals Logic for Games & Puzzles:** • Introduction Pseudo Code • Games and Logic • Puzzle and Logic • Identify Efficient Logic	2	-	3	-	5	10
2	**Fundamentals of Algorithmic Problem Solving:** • Important Problem types • Fundamentals of the analysis of algorithm efficiency – analysis frame work • Asymptotic Notations • Mathematical Analysis • Recursive • Non – Recursive	3	-	4	-	7	14
3.	**Divide and Conquer Method:** • Divide and Conquer Methodology • Merge Sort • Quick Sort • Binary Search • Binary • Multiplication of Large Integers • Strassen's Matrix Multiplication	3	-	4	-	7	14
4	**Introduction About Tree:** • Red – Black trees • Height balanced trees • AVL TREES, rotations • Definition of B – trees • Basic Operations on B – trees • Algorithm for sets	2	-	3	-	5	10

	5.	**Greedy Method:** • Prim's Algorithm • Kruskal's Algorithm • Dijkstra's Algorithm	2	-	3	-	5	10
	6.	**Dynamic Programming I:** • Binomial equation solving • Computing a binomial coefficient • Warshall's and floyd algorithm applications • Optimal binary • Search tree • Knapsack problem • Memory functions • Applications • Search tree • Knapsack problem • Memory functions • Applications	6	-	6	-	12	24
	7.	**Backtracking:** • Backtracking • N - Queens Problem • Hamiltonian Circuit Problem • Subset sum Problem • Applications	2	-	3	-	5	10
	8.	**Branch and Bound:** • Branch and bound • Assignment Problem • Knapsack Problem • Traveling Salesman Problem	2	-	3	-	5	10

	9.	**NP-HARPD AND NP – COMPLETE PROBLEMS IP & NP – Complete Problems:** • Approximation algorithms for NP- hard problems • Traveling salesman problem • Knapsack problem • Applications • Data searching application • Image retrieving application • Applications and corresponding algorithms • Sorting and searching applications	5	-	6	-	11	22
		Total	27	-	35	-	62	124

16. **Main references supporting the course:**

- Theory of Computation and Application- 2nd Edition (Automata, Formal Languages, Computational Complexity)- S.R. Jena, S.K. Swain
- Connected Liar's Domination in Graphs: Complexity And Algorithms
- Design and Analysis of Algorithms- (1st Edition)- S. R. Jena, S. Patro
- Efficient-Algorithms-for-Sorting-and-Synchronization- (Andrew-Tridgell, -PDF).html

<table>
<tr><td>1</td><td colspan="6">Name of Course/Module :MANAGERIAL COMMUNICATION</td></tr>
<tr><td>2</td><td colspan="6">Course Code: MGT 513</td></tr>
<tr><td>3</td><td colspan="6">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="6">Rationale for the inclusion of the course /module in the programme:
This course module enables students to learn communication strategically within a professional background. It helps to understand the importance of communication for the career and for the organization.</td></tr>
<tr><td>5</td><td colspan="6">Semester and Year offered: Year 1 Semester 1</td></tr>
<tr><td rowspan="3">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>O</td></tr>
<tr><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>58</td><td>22</td><td>-</td><td>6</td><td>80</td><td>166</td></tr>
<tr><td>7</td><td colspan="6">Credit Value:4</td></tr>
<tr><td>8</td><td colspan="6">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="6">Course Learning Outcomes:
On completion of this course students will be able to:
• Gain knowledge to construct effective correspondence, documents and presentations to inform, persuade and influence audience.
• Learn the skills to speak and write in a managerial environment to help develop and sharpen these critical skills.
• Organize material, structure a clear argument with the use of effective words and visual aids, voice and body language.</td></tr>
<tr><td>10</td><td colspan="6">Transferable Skills:
• Critical Thinking Skills
• Leadership and Administration Skills
• Information Management Skills
• Interpersonal Skills
• Assessing Values</td></tr>
<tr><td>11</td><td colspan="6">Teaching –learning and assessment strategy
• Lectures
• Interactive group work lectures with many examples
• Conferences given by Professors
• Syndicate working on case studies
• Individual Assignments</td></tr>
</table>

12	**Synopsis:** The course focuses on improving students' capacity to write, speak, work in a team, and communicate in the professional settings to become future managers. Students will learn to examine their intended audience, the role of good communication, and the circumstances in which they are operating.
13	**Mode of Delivery:** Lectures, Tutorials.
14	**Assessments Methods and Types:** Assignments 20% Mid Exam 20% Final Exam 50% Quiz 10% **Total 100%**
15	**Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1.	**Communication in General:** • Brief history of communication and its implications • Personal/professional/organizational objectives of communication • Importance of communication for the career and for the organization	4	2	-	-	6	12
2.	**Forms of Communication:** • Types - Patterns - Directions of communication • Advantages / Disadvantages of the various forms • Operational categories of communication **Barriers of Communication:** • Basic Communication Process Model • Medium - Channel - Noise – Feedback • Sensory Limitations	6	2	-	-	8	16

	3.	**Gateways of Communication:** • Gateways for each of these barriers. **Nonverbal Communication:** • Kinesics - Occulesics - Paralanguage -Proxemics - Haptics – Chronemics • Improving nonverbal communication **Intercultural Communication:** • Concepts of culture, culture centric behaviors and the ways to avoid them • Factors of differences in intercultural communication • Features of low-context and high-context cultures • Improving intercultural communication skills	8	2	-	-	10	20
	4.	**Listening:** • Process of listening • Barriers of effective listening • Effective v/s ineffective listening Types of listening and their roles **Speaking:** • Types of speaking according to mode of delivery • Types of speeches and tips for their delivery	5	2	-	-	7	14

	5.	**Etiquette:** • Meaning of Etiquette and its components • Business Etiquette in general and in social context **Presentation:** • Components and instruments of oral presentation. • Planning and delivering a presentation. **Interviews:** • Types of interviews and their functions • Steps and techniques of taking interviews • Steps and techniques of giving interviews	7	2	-	-	9	18
	6.	**Meetings:** • Types of meeting and components of meeting • Planning and conducting a meeting. Agenda, minutes and their parts.	2	2	-	-	4	8
	7.	**Business Letters:** • Types of business letters, their structure and format. • Essential and additional components. • Techniques of letter writing and the approaches. **Effective Business Writing:** • Planning, writing and completing a business message	5	2	-	-	7	14

	8.	**Sales correspondence:** • Types of Enquiries, components and techniques of writing • Orders, their components, and techniques of writing. • Components of replies and how to write them. **After-sales correspondence:** • Writing complaints and claims Writing adjustments and replies according to fault	5	2	-	-	7	14
	9.	**Banking Correspondence:** • Philosophy and essential features of banking correspondence • Components, types and techniques of collection writing **Official Correspondence:** • Types and components of agency letters and techniques of writing • Types of memos and various components • Essential features of circulars, notices and examples **Job correspondence:** • Essentials of a job campaign • Types of resumes, their functions and formats. • The techniques of application letter writing Post-Interview correspondence	8	2	-	-	10	20

	10.	**Electronic messages:** • Benefits, risks and limitations of various electronic media • Creating Emails - IM - Text messages **Persuasive messages:** • Philosophy and theories of persuasion • Elements of persuasion – Appeals Sales letters and the technique of sales writing	4	2	-	-	6	12
	11.	**Reports:** • Reports and their various types • Essential features of each types • The essential components of reports Techniques for report writing and examples	4	2	-	-	6	12
		Total	58	22		-	80	160

16. **Main references supporting the course:**

- Mary Ellen Guffey, Dana Loewy, "*Essentials of Business Communication*", South-Western College Pub. 10th edition (2015).
- *Excellence in Business Communication, Student Value* Edition (12th ed.), John V. Thill and Courtland L. Bovee. Pearson (2016)
- *Managerial Communication* by James S.O'Rourke, Prentice Hall; 5th edition (2012)

Others references supporting the course:

- *Lesikar's Business Communication, Connecting in a Digital World*, Kathryn Rentz and Marie Lentz and Paula Lentz McGraw- Hill, 12th edition (2010)
- *Business Communication: Developing Leaders for Leaders for a Networked World by Peter Cardon*. McGraw-Hill/Irwin;1st edition (2013)

<table>
<tr><td>1</td><td colspan="6">Name of Course/Module :OPEN SOURCE TECHNOLOGY</td></tr>
<tr><td>2</td><td colspan="6">Course Code: MCSO 123</td></tr>
<tr><td>3</td><td colspan="6">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="6">Rationale for the inclusion of the course /module in the programme:
This course helps to teach the students principles of open source technology, benefits of open source, and the product that includes permission to use its source code, design documents, or contents.</td></tr>
<tr><td>5</td><td colspan="6">Semester and Year offered: Year 1 Semester 1</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>O</td></tr>
<tr><td></td><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>31</td><td>2</td><td>27</td><td>6</td><td>60</td><td>126</td></tr>
<tr><td>7</td><td colspan="6">Credit Value:3</td></tr>
<tr><td>8</td><td colspan="6">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="6">Course Learning Outcomes:
On completion of this course students will be able to:
• Identify the needs and advantages of open sources.
• Demonstrate the creating and editing files with Vi-editor in a professional manner.
• Recognize the troubleshooting and log file analysis as a lifelong learning process.</td></tr>
<tr><td>10</td><td colspan="6">Transferable Skills:
• Ethics , moral and professionalism
• Information Management and Lifelong Learning</td></tr>
<tr><td>11</td><td colspan="6">Teaching –learning and assessment strategy
• Lectures
• Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.</td></tr>
<tr><td>12</td><td colspan="6">Synopsis:
The module helps students to study and understand the different open source licenses and how to start an open source project. This course module covers the topics introduction to open source, open source operating system, files directories and basic commands in linux, system administration basics.</td></tr>
<tr><td>13</td><td colspan="6">Mode of Delivery:
Lectures, Tutorials, Practical.</td></tr>
</table>

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Introduction to open source:** • Open source definition and principles • History, Open Source Initiative • Open Source Standards, Methodologies, Philosophy • Free source and open source system • Open source licensing system – Apache License, BSD license, GNU General Public License, GNU Lesser General Public License, and MIT License • Need and Advantages of Open sources	4	2	-	-	6	12

	2	**Open Source Operating System: Linux** • Historical development of Linux and Unix • Comparison among Linux, Unix, and Windows operating system • Features and advantages of Linux • Variants of Linux OS • Overview of Linux architecture • Linux installation, disk partitioning, logical volume manager • Virtual machine and containers installation	4	-	4	-	8	16
	3.	**Files, Directories and Basic Commands in Linux:** • Linux standard directories • File structure and hierarchy • Commands for files and directory handling (cd, ls, cp, rm, mkdir, pwd, file, more, less, cat) • File permission, changing permission and ownership (chmod, chown) • Touch, pwd, finger, passwd, date, head, tail, cut, sort, grep	3	-	3	-	6	12

	4	**System Administration Basics:** • Understanding boot process and related system files • Linux kernel fundamentals • Background processing • Process commands (kill, ps, who, top) • Creating and editing files with Vi-editor • Managing user accounts (add, delete, modify users) • Becoming super user • Creating and managing groups • Disk partition and sizes (df, du, dd,..) • Installing and removing packages (RPM, apt-get, yum..)	4	-	3	-	7	14

	5.	**Network configuration basics:**
		• Adding/removing network interfaces
		• IP addressing basics
		• Setting IPv4 and IPv6 static addressing
		• Configuring and running servers
		  o DHCP, DNS, Squid,
		  o Apache-HTTP, and Samba
		• Service monitoring commands (uname, hostname, dnsip, nslookup, dig)
		• Creating, starting, stopping and restarting service daemons
		• Conjob (at, anacron)
		• Remote file transfer (sshscp, ftp)
		• Troubleshooting, log file analysis
			6	-	6	-	12	24

	6.	**Fundamental of shell programming:**
		• Basics of shell programming
		• various types of shell available in Linux
		• Comparisons between various shells
		• Shell programming in bash
		  – Statement (Conditional, looping, case)
		  – System shell and environment variables
			2	-	3	-	5	10

	7.	**Database Administration:** • Fundamentals of open source databases (MySQL-MariaDB, PostgreSQL, MangoDB • SQL commands (DDL, DML, DCL) • Creating databases and tables in MariaDB • User privilege setting on database and tables • Running integrated web/database system: XAMPP, PHPmyAdmin	3	-	4	-	7	14
	8.	**Open Source Web Programming:** • Basics of web programming using PHP (HTML post and get) • Syntax and variables, operators and flow control structure in PHP • Built-in and user defined PHP function • Authentication and session management • Hosting web server, document root management • Programming databases in PHP – Basics of PHP data objects • Database connection and query execution	5	-	4	-	9	18
		Total	31	2	27	-	60	120

16.	**Main references supporting the course:** • Redhat Linux • Administration Wiley • Linux Shell scripting Cookbook: SarathLakshman PACKT • Linux Lab – Open source Technology: AmbavadeDreamtech • Beginning Adnorid Development Wrox Press. • Drupal guide to Planning and Building Web Site: Wrox Press.

<table>
<tr><td>1</td><td colspan="7">Name of Course/Module :TELECOMMUNICATION SYSTEMS</td></tr>
<tr><td>2</td><td colspan="7">Course Code: MCS 115</td></tr>
<tr><td>3</td><td colspan="7">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="7">Rationale for the inclusion of the course /module in the programme:
This module is aimed to produce potential experts for the design and administration of high-performance telecommunication networks for the applications of fixed and mobile networks based on sophisticated telecommunication systems and intricate infrastructures.</td></tr>
<tr><td>5</td><td colspan="7">Semester and Year offered: Year 1 Semester 1</td></tr>
<tr><td rowspan="3">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>O</td></tr>
<tr><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>38</td><td>1</td><td>23</td><td>6</td><td>62</td><td>130</td></tr>
<tr><td>7</td><td colspan="7">Credit Value:3</td></tr>
<tr><td>8</td><td colspan="7">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="7">Course Learning Outcomes:
On completion of this course students will be able to:
• Demonstrate in-depth knowledge of the disciplinary foundations of the relevant sub-fields to the field of Telecommunication.
• Analyze entire systems as well as sub-systems in Telecommunication in the group Assignment.
• Identify their need for further development of skills in the field of Tele communication.</td></tr>
<tr><td>10</td><td colspan="7">Transferable Skills:
• Communication skills
• Critical Thinking & Problem Solving Skills
• Information Management & Lifelong Learning</td></tr>
<tr><td>11</td><td colspan="7">Teaching –learning and assessment strategy
• Lectures
• Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.</td></tr>
<tr><td>12</td><td colspan="7">Synopsis:
This module provides wide range of knowledge in wireless, wired and optical transmission systems, network architectures and protocols along with some aspects of computer science. As a result the professionals are multi-field experts.</td></tr>
<tr><td>13</td><td colspan="7">Mode of Delivery:
Lectures, Tutorials, Practical.</td></tr>
</table>

14	**Assessments Methods and Types:** Assignments 20% Mid Exam 20% Final Exam 50% Quiz 10% **Total 100%**
15	**Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lectur	Tutorial	Practica	Others		
1	**Introduction to Telecommunication:** • Evolution of telecommunications • Classification of switching system	2	1	-	-	3	6
2	**Data Communications:** • Introduction • OSI Model • Data encoding by line coding • Asynchronous and Synchronous Transmission • Error Detection • Interfacing • Data link Layer • Routing in packet switched networks • Flow and congestion control • LAN, MAN and WAN	6	-	3	-	9	18

	3.	**Multiplexing and Switching:** • Frequency division multiplex, Wavelength division multiplex • Space division multiplex • Time division multiplex; North American TDM system, The European E1 • Digital Telephone Exchange • Space(S) Switch,Time(T) Switch • ST, TS, STS and TST switch • Comparison between TST and STS switch	5	-	3	-	8	16
	4	**Satellite Communication:** • Fundamental of satellite communication • Satellite orbit and radio spectrum • Satellite wave propagation and satellite antennas • Digital satellite communication systems • Earth stations • Kepler's laws of orbital motion • Signal to noise ratio • Interference between different wireless systems • Level diagram • Link budget calculation • VSAT, Iridium, Global Star, GMPCS, GPS system and INTELSAT/INMARSAT	6	-	3	-	9	18

	5.	**Wireless Communication:** ● Evolution from 1G to 5G. ● GSM Architecture ● Propagation theory ● Digital Modulation techniques: BPSK,DPSK,QPSK, FDMA, GMSK) ● Multiplexing techniques: TDMA,FDMA, CDMA technologies (DECT, GSM, CDMA 2000)	5	-	3	-	8	16
	6.	**Fiber Optic Communication:** ● Introduction to optical fibers ● Optical fiber as communication channels ● Electro-Optic components ● Total internal reflection ● Snell's law ● Optical Fiber types and properties ● Optical transmission ● Optical transmitters and receivers ● Splices, connectors and coupling ● Fiber Optics Networks ● Optical switching ● Submarine cable	5	-	4	-	9	18

	7.	**Modern Telecommunication:** ● Stored Programmed Controlled switch ● No 7 signaling ● ISDN, BISDN ● ATM, PDH/SDH, DSL ● Radar system ● Navigational systems ● Numbering, Routing and charging plans ● LTE, UMTS, IMT-2000, IMS, NGN, MPLS, ● Real time protocol, ● Voice over IP, IP/PSTN Platform, IN, SSP, SCP, SCP, SSP, SMS ● Basics of GIS	6	-	5	-	11	22
	8.	**Telecommunication Regulation:** ● ITU (International Telecommunications Union) ● ITU-T ● ITU-D ● ITU-R ● NTA(Nepal Telecommunications Authority) and Regulation policies	3	-	2	-	5	10
		Total	38	1	23	-	62	124

16. **Main references supporting the course:**

- Behrouz A. Forouzan*Data Communications and Networking*,5th Edition
- Roger L. Freeman "*Telecommunication System Engg.* " John Wiley & Sons, Inc.
- ThiagarajanVishwanathan ,*Telecommunication Switching Systems and Networks*
- T.L.Singal, *Optical Fiber Communications Principle and Applications*,Cambridge University Press
- Dennis Roddy,Satellite Communications

II SEMESTER

<table>
<tr><td>1</td><td colspan="7">Name of Course/Module :DATA WAREHOUSING & BIG DATA</td></tr>
<tr><td>2</td><td colspan="7">Course Code: DWB 121</td></tr>
<tr><td>3</td><td colspan="7">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="7">Rationale for the inclusion of the course /module in the programme:
This course enables the students to learn basic concepts and application of data warehousing and data mining with its issues.</td></tr>
<tr><td>5</td><td colspan="7">Semester and Year offered: Year 1 Semester 2</td></tr>
<tr><td rowspan="3">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>O</td></tr>
<tr><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>40</td><td>8</td><td>32</td><td>6</td><td>80</td><td>166</td></tr>
<tr><td>7</td><td colspan="7">Credit Value:4</td></tr>
<tr><td>8</td><td colspan="7">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="7">Course Learning Outcomes:
On completion of this course students will be able to:
• Describe the functionalities of data mining and architecture of data warehouse.
• Identify the issues by using data mining techniques, tools and application to minimize the problem.
• Present the computation of data cubes and modeling in a team..</td></tr>
<tr><td>10</td><td colspan="7">Transferable Skills:
• Critical thinking and Problems Solving Skills
• Communication Skill
• Teamwork
• Information Management and Lifelong Learning</td></tr>
<tr><td>11</td><td colspan="7">Teaching –learning and assessment strategy
• Lectures
• Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.</td></tr>
<tr><td>12</td><td colspan="7">Synopsis:
This course is designed to deliver in depth knowledge about distributed and virtual data warehouse. The main focus is to handle data mining query languages and advanced concepts in data mining. It includes OLAP technology for data mining and tuning for data warehouse.</td></tr>
<tr><td>13</td><td colspan="7">Mode of Delivery:
Lectures, Tutorials, Practical.</td></tr>
</table>

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Introduction:** • What motivated data mining? What is data Mining? • Types of database (Relational database, data warehouses, transactional database) • Functionalities of data mining – what kinds of pattern can be mined? • Association Analysis, cluster Analysis, outlier analysis, evolution analysis • Stages of knowledge discovery in database (KDD) • Setting up a KDD Environment • Issues in data warehouse and Data Mining • Application of Data Warehouse and Data mining	8	5	-	-	13	26

	2	**Data Warehousing for Data Mining:** • Differences between operational database systems and • data warehouses • Data Warehouse Architecture • Distributed and Virtual Data Warehouse • Data Warehouse Manager • Data marts, Metadata, Multidimensional data model • From Tables and Spread Sheets to Data Cubes • Star schema, Snowflake schema and Fact constellation • Schema	6	3	-	-	9	18
	3.	**OLAP Technology for Data Mining:** • On-line analytical processing models and operations • (drill down, drill up, slice, dice, pivot) • Types of OLAP Servers: ROLAP versus MOLAP • versus HOLAP • OLTP	4	-	6	-	10	20
	4	**Tuning for Data Warehouse:** • Computation of Data Cubes, modeling • OLAP data, OLAP queries • Data Warehouse back end tools • Tuning and testing of Data Warehouse	4	-	5	-	9	18
	5.	**Data Mining Techniques:** • Data Mining definition and Task • KDD versus Data Mining • Data Mining techniques, tools and application	2	-	3	-	5	10

	6.	**Data Mining Query Languages:** • Data mining query languages • Data specification, specifying knowledge, hierarchy • specification, pattern presentation & visualization • specification • Data mining languages and standardization of data • Mining	4	-	5	-	9	18
	7.	**Association Analysis:** • Association Rule Mining (Market basket analysis) • Why Association Mining is necessary? • Pros and Cons of Association Rules • Apriori Algorithm	2	-	3	-	5	10
	8.	**Cluster Analysis, Classification and Predication:** • What is classification? What is predication? • Issues regarding classification and prediction (Preparing • the data for classification and prediction, Comparing • classification methods) • Classification by decision tree induction (Extracting • classification rules from decision trees) • Bayesian Classification • Classification by back propagation • Introduction to Regression (Types of Regression) • Clustering Algorithm (K-mean and K-Mediod Algorithms)	8	-	7	-	15	30

	9.	**Advanced Concepts in Data Mining:** • Mining Text Databases. • Mining the World Wide Web • Mining Multimedia and Spatial Databases	2	-	3	-	5	10
		Total	40	8	32	-	80	160

16. **Main references supporting the course:**

- *Data Mining Concepts and Techniques*, Morgan Kaufmann J. Han, M Kamber Second Edition ISBN: 978-1-55860-901-3
- *Data Warehousing in the Real World* – Sam Anahory and Dennis Murray, Pearson Edition Asia.

Additional references supporting the course:

- *Data Mining Techniques* – Arun K Pujari, University Press.
- *Data Mining*- Pieter Adriaans, DolfZantinge
- *Data Mining*, Alex Berson,StephenSmith,KorthTheorling,TMH.

<table>
<tr><td>1</td><td colspan="7">Name of Course/Module :DATA ANALYTICS & VISUALIZATION</td></tr>
<tr><td>2</td><td colspan="7">Course Code: DAV 234</td></tr>
<tr><td>3</td><td colspan="7">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="7">Rationale for the inclusion of the course /module in the programme:
This course module introduces students to the field by covering data modeling, analysis and visualization techniques through established theories.</td></tr>
<tr><td>5</td><td colspan="7">Semester and Year offered: Year 1 Semester 2</td></tr>
<tr><td rowspan="3">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>O</td></tr>
<tr><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>40</td><td>2</td><td>40</td><td>6</td><td>82</td><td>170</td></tr>
<tr><td>7</td><td colspan="7">Credit Value:4</td></tr>
<tr><td>8</td><td colspan="7">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="7">Course Learning Outcomes:
On completion of this course students will be able to:
• Demonstrate lookup functions using VLOOKUP to find data in a professional manner.
• Create multiple versions of digital visualizations using various software packages to work on your own.
• Communicate clearly and effectively results from analyses performed to others.</td></tr>
<tr><td>10</td><td colspan="7">Transferable Skills:
• Communication skills
• Teamwork
• Ethics, moral and professionalism</td></tr>
<tr><td>11</td><td colspan="7">Teaching –learning and assessment strategy
• Lectures
• Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.</td></tr>
<tr><td>12</td><td colspan="7">Synopsis:
The main focus of this course is to provide students with the foundations necessary for understanding and extending the current state of the art in data visualization. It gives hands on skills to the students on observing visualizations in different field.</td></tr>
<tr><td>13</td><td colspan="7">Mode of Delivery:
Lectures, Tutorials, Practical.</td></tr>
</table>

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Introducing Data Visualization:** • What is data visualization? • Understanding Data Visualization • Importance of Data Visualization • Impact of data visualization • Principles of good data representation • Recognizing the Traits of Good Data Viz; Embracing the Design Process; • Ensuring Excellence in Your Data Visualizations	5	2	-	-	7	14
2	**Exploring Common Types of Data Visualization:** • Data visualization Vs. Infographics • Picking the right content type • Appreciating interactive data visualization • Observing visualizations in different fields; using dashboards • Discovering infographics	4	-	5	-	9	18

	3.	**Analysing Data Using Excel:** **Tables** • What is a table? • Creating tables • Changing the table range • Inserting table columns • Inserting table rows • Deleting rows or columns • Creating a table total row • Sorting and filtering tables • Sorting data in a table **Dates** • Dates and time in Excel • Inserting and formatting dates • Entering date functions • Using dates in formulas **Charts** • Creating a chart • Manipulating a chart • Moving and resizing a chart • Adding a chat title • Adding a chart axis title • Changing the type of chart • Formatting a chart **Conditional Formulas and Formatting** • The IF Function • Using the function library • Manually entering a function • Conditional formatting • Applying conditional formatting **Lookup Functions** • Using VLOOKUP to find data • How to find an exact match with VLOOKUP • Finding the closest match with VLOOKUP	13	-	10	-	23	46

		• How to use the MATCH function • Index function • Lookup using match and index function **Pivot tables and pivot charts** • What is a pivot table? • Preparing data to create a pivot table • Creating a pivot table • Quick analysis • Adding fields to the pivot table • Creating a pivot table frame (Classic pivot table layout) • Rearranging pivot table data • Hiding and showing field data • The pivot table tools ribbon **Macros** • What is a macro? • Creating a macro • The developer ribbon • Recording a macro • Playing a macro						
	4.	**Introduction to Data Visualization Using Tableau:** • Working with tableau • Deep diving with data and connection • Creating charts • Mapping data in tableau • Dashboards and stories – Best practices for effective dashboards – Telling a story with data	3	-	5	-	8	16

	5.	**Introduction to Data Visualization Using R:** • Installing R and Rstudio • A tour of Rstudio • Vectors in R • Data frames • Working with ggplot • Installing ggplot2 • Plotting a poing with ggplot • Controlling axis properties • More with color and shape • Graphing lines with ggplot • More with lines • Sampling from populations • Normal populations • Plotting a vertical sample • Plotting several vertical samples • Samples along a line • Sapply • Cloud of points	5	-	8	-	13	26

	6.	**Introduction to Programming with Python:** **A. Introduction to programming with python** • Hands on with python and jupyter notebooks • Variables and data types • Conditional statements and loops • Reusable coding: functions • Arithmetic operations • Manipulate data types **B. Numerical computing with numpy** • Python lists to numpy arrays • Multi-dimensional arrays • Array operations, slicing and broadcasting • Working with CSV data files **C. Analyzing Tabular Data with Pandas** • Reading and Writing CSV data with pandas • Querying, filtering and sorting data frames • Grouping andaggregation for data summarization • Merging and joining data from multiple sources **D. Visulatization with Matplotlib and Seaborn** • Basic visualization with matplotlib • Advanced visualizations with seaborn • Customizing and styling charts • Plotting images and grids of charts	10	-	12	-	22	44
		Total	40	2	40	-	82	164

16.	**Main references supporting the course:** • *Python for Data Analysis*, by W. McKinney, O'REILLY Media, 2nd Edition. 2017 • *Python Data Science Handbook* by Jake VanderPlas Online Open Book • *Data Visualization: A Practical Introduction by Kieran Healy* 1st Edition The Handbook of Data Visualization • T. J. Bringham (2016), *Feast for the Eyes: An Introduction to Data Visualization, Medical Reference Services Quarterly, Volume* 35, 2016 - Issue 2, Pages 215- 223 http://dx.doi.org/10.1080/02763869.2016.1152146 **Additional references supporting the course:** • *SAS (2017), Data Visualization: What it is and why it matters. URL: https://www.sas.com/en_us/insights/big-data/data-visualization.html Last accessed: 26th August 2017* • *J. Steele & N. Iliinsky (2010), Beautiful Visualization: Looking at Data through the Eyes of Experts (Theory in Practice), O'Reilly Media; 1 edition (July 1, 2010). ISBN-13: 978-1449379865* • *IBM (2017), IBM Design: Art meets science - Data visualization guidelines. URL: https://www.ibm.com/design/language/experience/data-visualization Last accessed: 26th August 2017*

<table>
<tr><td>1</td><td colspan="6">Name of Course/Module :CYBER SECURITY</td></tr>
<tr><td>2</td><td colspan="6">Course Code: CS 123</td></tr>
<tr><td>3</td><td colspan="6">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="6">Rationale for the inclusion of the course /module in the programme:
This course module provides the study and the practice of ensuring the integrity, confidentiality, and availability (ICA) of information. It also helps to study the security trends.</td></tr>
<tr><td>5</td><td colspan="6">Semester and Year offered: Year 1 Semester 2</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>O</td></tr>
<tr><td></td><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>48</td><td>11</td><td>21</td><td>6</td><td>80</td><td>166</td></tr>
<tr><td>7</td><td colspan="6">Credit Value:4</td></tr>
<tr><td>8</td><td colspan="6">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="6">Course Learning Outcomes:
On completion of this course students will be able to:
• Identify the information security threats and attack vectors.
• Demonstrate the various scanning tools.
• Analyze different approaches of vulnerability assessment solutions for lifelong learning process.</td></tr>
<tr><td>10</td><td colspan="6">Transferable Skills:
• Critical Thinking & Problem Solving Skills
• Information Management & Lifelong Learning</td></tr>
<tr><td>11</td><td colspan="6">Teaching –learning and assessment strategy
• Lectures
• Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.</td></tr>
<tr><td>12</td><td colspan="6">Synopsis:
Cyber security course is comprised of an evolving set of tools, risk management approaches, technologies, training, and best practices designed to protect networks, devices, programs, and data from attacks or unauthorized access.</td></tr>
<tr><td>13</td><td colspan="6">Mode of Delivery:
Lectures, Tutorials, Practical.</td></tr>
</table>

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Introduction to Ethical Hacking** • Overview of Current Security Trends • Elements of Information Security • Information Security Threats and Attack Vectors • Hacking Concepts, Types and Phases • Ethical Hacking Concepts and Scope • Information Security Controls • Penetration Testing • Information Security Acts and Laws	5	2	-	-	7	14

	2	**Foot printing and Reconnaissance:** • Foot Printing Concepts • Foot Printing through Search Engines and Advanced Google Hacking Techniques • Foot Printing through Web Services and Social Networking Sites • Website Foot Printing, Email Foot Printing and Competitive Intelligence • WHOIS, DNS and Network Foot Printing • Foot Printing through Social Engineering • Different Foot Printing Tools and Countermeasures • Foot Printing Penetration Testing	5	2	-	-	7	14
	3.	**Scanning Networks:** • Network Scanning Concepts • Scanning Tools • Scanning Techniques • Techniques to Scan Beyond IDS and Firewall • Banner Grabbing • Drawing Network Diagrams • Scanning Pen Testing	4	-	2	-	6	12

	4	**Enumeration:** • Enumeration Concepts • Different Techniques for Net BIOS Enumeration • Different Techniques for SNMP Enumeration • Different Techniques for LDAP and NTP Enumeration • Different Techniques for SMTP and DNS Enumeration • Other Enumeration such as IPSec, VoIP, RPC and Linux/Unix Enumeration • Different Enumeration Countermeasures • Enumeration Pen Testing	4	-	5	-	9	18
	5.	**Vulnerability Analysis:** • Vulnerability Research and Vulnerability Classification • Vulnerability Assessment • Vulnerability Management Life Cycle • Approaches of Vulnerability Assessment Solutions • Types of Vulnerability Assessment Tools	2	-	2	-	4	8
	6.	**System Hacking:** • CEH Hacking Methodology • Techniques to Gain Access to the system • Privilege escalation techniques • System hacking Penetration Testing	2	-	1	-	3	6

	7.	**Malware Threats:** • Malware and Malware Propagation Techniques • Trojans, their types and how they infect systems • Viruses, their types and how they infect files • Computer worms	2	-	1	-	3	6
	8.	**Sniffing:** • Various sniffing techniques • How to defend against various sniffing techniques • Different techniques to detect sniffing	2	-	1	-	3	6
	9.	**Social Engineering:** • Social Engineering concepts and techniques • Insider threats • Theft Identification • Social engineering countermeasures	2	1	-	-	3	6
	10.	**Denial of Service:** • DoS/DDoS attack techniques • Botnet Network • DoS and DDoS attack tools • Techniques to detect DoS and DDoS attacks	2	-	2	-	4	8
	11.	**Session Hijacking:** • Application level session hijacking • Network level session hijacking • Session hijacking tools • Session hijacking countermeasures	2	-	2	-	4	8

	12.	**Evading IDS, Firewalls and Honey pots:** • IDS, Firewall and Honey pot Solutions • Techniques to Bypass IDS • Techniques to Bypass Firewalls • IDS/ Firewall evading tools • Techniques to detect honeypots	2	-	2	-	4	8
	13.	**Hacking Web Servers:** • Web Server Attacks • Web Server Attack Methodology • Different web server attack countermeasures • Patch Management Concepts • Web server security tools	2	-	2	-	4	8
	14.	**Hacking Web Applications:** • Web Application concepts • Web Application threats • Web Application Hacking Methodology • Web Application Hacking Tools	2	1	-	-	3	6
	15.	**SQL Injection:** • Types of SQL Injection Attacks • SQL Injection Methodology • SQL Injection Tools	2	1	-	-	3	6
	16.	**Hacking Wireless Networks:** • Wireless Encryption Algorithms • Wireless threats • Wireless hacking methodology • Different wireless hacking tools	2	1	-	-	3	6

	17.	**Hacking Mobile Platforms:** • Mobile Platform Attack Vectors • Android Threats and Attacks • iOS Threats and Attacks • Mobile security guidelines and security tools	2	-	1	-	3	6
	18.	**IoT Hacking:** • IoT Concepts • IoT Threats and Attacks • IoT Hacking Countermeasures • IoT Security Tools	2	1	-	-	3	6
	19.	**Cloud Computing:** • Cloud Computing Threats • Cloud Computing Attacks • Cloud Computing Security	1	1	-	-	2	4
	20.	**Cryptography:** • Cryptography Algorithms • Cryptography Tools • Email Encryption • Cryptanalysis Tools	1	1	-	-	2	4
		Total	48	11	21	-	80	160

16. **Main references supporting the course:**

- *Hacking: The Art of Exploitation* (2nd Ed.), Author: Jon Erickson
- *The Art of Invisibility: The World's Most Famous Hacker Teaches You How to Be Safe in the Age of Big Brother and Big Data*, Author: Kevin Mitnick
- *Ghost in the Wires: My Adventures as the World's Most Wanted Hacker*, Author(s): Kevin Mitnick, William L. Simon
- *The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography*, Author(s): Joseph Menn

<table>
<tr><td>1</td><td colspan="7">Name of Course/Module :ARTIFICIAL INTELLIGENCE</td></tr>
<tr><td>2</td><td colspan="7">Course Code: AFI 124</td></tr>
<tr><td>3</td><td colspan="7">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="7">Rationale for the inclusion of the course /module in the programme:
This course is designed to impart basic concepts and history on artificial intelligence. It explores use cases and applications of AI and terms like machine learning, deep learning.</td></tr>
<tr><td>5</td><td colspan="7">Semester and Year offered: Year 1 Semester 2</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
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<tr><td></td><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>36</td><td>4</td><td>22</td><td>6</td><td>62</td><td>130</td></tr>
<tr><td>7</td><td colspan="7">Credit Value:3</td></tr>
<tr><td>8</td><td colspan="7">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="7">Course Learning Outcomes:
On completion of this course students will be able to:
Evaluate the advantages, disadvantages, challenges, and ramifications of human–AI augmentation.
Show the limitations of current Artificial Intelligence techniques with an appropriate presentation.
Obtain relevant information to learn the structure and properties of intelligent agent useful for lifelong learning.</td></tr>
<tr><td>10</td><td colspan="7">Transferable Skills:
Communication skills
Teamwork
Entrepreneurship skills
Information Management and Lifelong Learning</td></tr>
<tr><td>11</td><td colspan="7">Teaching –learning and assessment strategy
Lectures
Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.</td></tr>
<tr><td>12</td><td colspan="7">Synopsis:
The main purpose of this course is to provide the most fundamental knowledge to the students so that they can understand what the Artificial Intelligence is. This course deals with the foundations of AI: Philosophy, Economics, psychology, sociology and linguistics.</td></tr>
<tr><td>13</td><td colspan="7">Mode of Delivery:
Lectures, Tutorials, Practical.</td></tr>
</table>

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Introduction:** • Intelligence, Artificial Intelligence (AI), AI Perspectives: acting and thinking humanly, acting and thinking rationally • History of AI • Foundations of AI: Philosophy, Economics, Psycology, Sociology, Linguistics • Neuroscience, Mathmatics, Computer Science, Control Theory • Applications of AI	3	2	-	-	5	10
2	**Intelligent Agents:** • Introduction of agents, Structure of Intelligent agent, Properties of Intelligent Agents • Configuration of Agents, PEAS description of Agents, PAGE • Types of Agents: Simple Reflexive, Model Based, Goal Based, Utility Based, Learning Agent • Environment Types: Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent	3	2	-	-	5	10

	3.	**Problem Solving by Searching:** • Definition, State space representation, Problem as a state space search, Problem formulation, Well defined problems • Solving Problems by Searching, Search Strategies: Informed, Uninformed, Performance evaluation of search strategies: Time Complexity, Space Complexity, Completeness, Optimality • Uninformed Search: Depth First Search, Breadth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, • Bidirectional Search • Informed Search, Heuristic Function, Admissible Heuristic, Informed Search Techniques: Greedy Best First Search, A* Search, Optimality and Admissibility in A*, Hill Climbing Search, Simulated Annealing Search • Game Playing, Adversarial Search Techniques: Mini-max Search, Alpha-Beta Pruning • Constraint Satisfaction Problems, Examples of Constraint Satisfaction Problems	8	-	5	-	13	26

	4.	**Knowledge Representation:** • Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, • Properties ofKnowledge Representation Systems • Types of Knowledge Representation Systems: Semantic Nets, Frames, Conceptual • Dependencies, Scripts, Rule Based Systems (Production System), Propositional Logic, Predicate Logic • Propositional Logic(PL): Syntax, Semantics, Formal logic-connectives, truth tables, tautology, validity, well-formed-formula, Inference using Resolution, Backward Chaining and Forward Chaining • Predicate Logic: FOPL, Syntax, Semantics, Quantification, Inference with FOPL: By converting into PL (existential and universal instantiation), Unification and lifting, Inference using resolution	8	-	6	-	14	28

	5.	**Machine Learning:** • Introduction to Machine Learning, Concepts of Learning, Supervised, Unsupervised and • Reinforcement Learning • Statistical-based Learning: Naive Bayes Model • Learning by Genetic Algorithms: Operators in • Genetic Algorithm: Selection, Mutation, • Crossover, Fitness Function, Genetic Algorithm • Learning with Neural Networks: Introduction, Biological Neural Networks Vs. Artificial Neural Networks (ANN), Mathematical Model of ANN, Activation Functions: Linear, Step Sigmoid, Types of ANN: Feed-forward, Recurrent, Single Layered, Multi-Layered, Application of Artificial Neural Networks, Learning by Training ANN, Supervised vs. Unsupervised Learning, Hebbian Learning, Perceptron Learning, Back-propagation Learning	8	-	6	-	14	28

	6.	**Applications of AI:** • Expert Systems, Components of Expert System: Knowledge base, inference engine, user interface, working memory, Development of Expert Systems • Natural Language Processing: Natural Language • Understanding and Natural Language Generation, Steps of Natural Language Processing: Lexical Analysis(Segmentation, Morphological Analysis), Syntatic Analysis, Semantic Analysis, Pragmatic Analysis, Machine Translation, • Machine Vision Concepts: Machine vision and its applications, Components of Machine Vision System	6	-	5	-	11	22
		Total	36	4	21	-	62	124

16. **Main references supporting the course:**

- *Stuart Russel and Peter Norvig, Artificial Intelligence A Modern Approach*, Pearson Reference Books
- George F. Luger*, Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, Benjamin/Cummings Publication
- E. Rich, K. Knight, Shivashankar B. Nair, *Artificial Intelligence*, Tata McGraw Hill.
- D. W. Patterson, *Artificial Intelligence and Expert Systems*, Prentice Hall.
- P. H. Winston, *Artificial Intelligence*, Addison Wesley.

<table>
<tr><td>1</td><td colspan="7">Name of Course/Module :DIGITAL MARKETING</td></tr>
<tr><td>2</td><td colspan="7">Course Code: MCS 125</td></tr>
<tr><td>3</td><td colspan="7">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="7">Rationale for the inclusion of the course /module in the programme:
This module is introduced to provide knowledge on importance of digital marketing and how digital marketing can be the ultimate tool for success for business.</td></tr>
<tr><td>5</td><td colspan="7">Semester and Year offered: Year 1 Semester 2</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
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TSLT=Total student learning time</td><td>34</td><td>2</td><td>24</td><td>6</td><td>60</td><td>126</td></tr>
<tr><td>7</td><td colspan="7">Credit Value:3</td></tr>
<tr><td>8</td><td colspan="7">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="7">Course Learning Outcomes:
On completion of this course students will be able to:
• Describe about brand awareness, credibility and deliver among consumers.
• Identify the email marketing platforms and its importance to build venture and grab businessOpportunity.
• Obtain relevant information on brand awareness, credibility and deliver among consumers as per lifelong learning.</td></tr>
<tr><td>10</td><td colspan="7">Transferable Skills:
• Information Management and Lifelong Learning
• Entrepreneurship skills</td></tr>
<tr><td>11</td><td colspan="7">Teaching –learning and assessment strategy
• Lectures
• Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.</td></tr>
<tr><td>12</td><td colspan="7">Synopsis:
The main aim of this course is to impart thorough information about philosophies and practices of marketing and digital marketing technologies. It also provides students with sufficient background that will allow them to pursue their careers in the Digital Marketing area. It includes planning and creating a website, search engine optimization, social media marketing and content strategy.</td></tr>
<tr><td>13</td><td colspan="7">Mode of Delivery:
Lectures, Tutorials, Practical.</td></tr>
</table>

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Introduction to Digital Marketing:** • Importance of digital marketing • How can digital marketing be the ultimate tool for success for businesses? • How to conduct a competitive analysis • Case studies regarding strategies involved • Marketing automation • Digital analysis	6	2	-	-	8	16
2	**Planning and Creating a Website:** • Brand awareness, credibility & deliver among consumers • Practical demonstration on how to create a website • How to incorporate design and other elements into the website	4	-	2	-	6	12
3.	**Search Engine Optimization (SEO):** • On-page Optimization • Keywords • History & growth of SEO • Off-page Optimization • Google Ad words	3	-	3	-	6	12
4	**Search Engine Marketing (SEM):** • Introduction to SEM • Site targeting • Keyword Targeting • CPC, CPA & CPM based accounts • Demographic targeting bidding	5	-	3	-	8	16

	5.	**Social Media Marketing:** • Definition of Social Media marketing and Social Media • Blogging • Social networking • Use of different social media platforms • Video creating & sharing • Content creation	5	-	5	-	10	20
	6.	**Content Strategy:** • CTC via content • Article marketing • Promotions • Content marketing tools	2	-	2	-	4	8
	7.	**Web Analytics:** • Introduction to web Analytics • Campaign tagging & reporting • Using googleadwords data • Linking • Real time data	3	-	3	-	6	12
	8.	**Email Marketing:** • Importance of Email Marketing • Email marketing platforms • Create forms • Create Opt-in lists • Creating & trackingemailers	3	-	3	-	6	12
	9.	**E-Commerce Management:** • E-commerce marketing • Product keyword research • Uploading products to website • Inventory management • Supply chain management • Pay per click	3	-	3	-	6	12
		Total	34	2	24	-	60	120

16. **Main references supporting the course:**

- *Digital Marketing for Dummies* by Ryan Desis& Russ Henneberry
- Youtility by Hay Baer
- *Epic content Marketing* by Joe Pulizzi
- *New Rules of Marketing and PR* by David Meerman Scott
- *Hit Makers: The Science of Popularity in an Age of Digital Distraction* by Derek Thompson

III SEMESTER

<table>
<tr><td>1</td><td colspan="7">Name of Course/Module :TECHNOPRENEURSHIP</td></tr>
<tr><td>2</td><td colspan="7">Course Code: TCP231</td></tr>
<tr><td>3</td><td colspan="7">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="7">Rationale for the inclusion of the course /module in the programme:
The course is designed to explore the entrepreneurial mindset and culture utilizing a technology or engineering background. It provides an introduction to the rapidly evolving technical world of creative new ventures that utilizes internet marketing.</td></tr>
<tr><td>5</td><td colspan="7">Semester and Year offered: Year 2 Semester 3</td></tr>
<tr><td rowspan="3">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>O</td></tr>
<tr><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>52</td><td>28</td><td>-</td><td>6</td><td>80</td><td>166</td></tr>
<tr><td>7</td><td colspan="7">Credit Value:4</td></tr>
<tr><td>8</td><td colspan="7">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="7">Course Learning Outcomes:
On completion of this course students will be able to:
• Describe the entrepreneurial process from the generation of creative ideas.
• Analyse the relevant information of market needs and provide a solution to a key problem.
• Identify the various challenges in technopreneurship.</td></tr>
<tr><td>10</td><td colspan="7">Transferable Skills:
• Problem Solving and Critical Thinking
• Lifelong Learning Learning and Information Management
• Leadership skills
• Ability to plan and organize theoretical learning as well as appliedlearning
• Evaluating results</td></tr>
<tr><td>11</td><td colspan="7">Teaching –learning and assessment strategy
• Lectures
• Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.</td></tr>
<tr><td>12</td><td colspan="7">Synopsis:
This course intends to give an understanding of Technopreneurship fundamentals which will further encourage science and engineering students to explore the entrepreneurial and R&D career paths. It covers the topics like introduction to entrepreneurship, idea creation, innovation & creativity and product identification.</td></tr>
</table>

13	**Mode of Delivery:** Lectures, Tutorials
14	**Assessments Methods and Types:** Assignments 20% Mid Exam 20% Final Exam 50% Quiz 10% **Total 100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Understanding Technopreneurship:** • Concept of technopreneurship • TechnopreneurVs Entrepreneur • Traits and characteristics of technopreneur • Importance of technopreneurship • Successful global and local technopreneurs • Challenges in technopreneurship	5	3	-	-	8	16

	2	**Idea, Innovation & Creativity:** • Basic concepts in Idea, innovation & creativity • Characteristics of an Innovative or a creative Individual • Process involved and techniques • Principles of Innovation • Research vs development – translational research • Types of innovation: product, process, and business model • Innovation-driven vs small-medium enterprise • Organization-driven vs market-driven ideas • importance of Creativity and Innovation • Factors that impact innovation and creativity	7	2	-	-	9	18
	3.	**Value Proposition:** • Benefits vs features, relation to needs, and high value adding • Solution driven or efficiency improvement • Value proposition statement including Needs, Approach, Benefits per cost, Competition	3	2	-	-	5	10
	4	**Market Research & Customers Identification** • Customer needs, pain points and demographics • Market research and validation • The decision-making process • Target customer profile, persona	3	2	-	-	5	10

	5.	**Competitive Advantage & Markets:** • Classes of competitors • Product differentiation, positioning • Market structures • Market segments, size • Beachhead market and creating your market	3	2	-	-	5	10
	6.	**Introduction to Intellectual Property:** • Needs of intellectual property • Types of intellectual property • Procedure to register • Intellectual property of a product • Importance of intellectual property in business • Copyright & trademarks regulations • Patents, trade secrets, contracts, non-disclosure and non-compete agreements	6	2	-	-	8	16

	7.	**Planning IT Business & Execution:** • Principles and concepts of business ownership • Types of business ownership • Factors that influence entrepreneurial venture. • Factors that influence in starting a new entrepreneurial venture • Roadmap for research, development, and production • Develop IT Business Plan. • Importance of a Business Plan. • Criteria of a good Business Plan. • Determine business plan outline • IT business plan • Sales and marketing plans; cost of customer acquisition, customer lifetime value • Plans for R&D, operations, sales and marketing, human resources • Lean concepts and organization	8	4	-	-	12	24

	8.	**Financial Analysis and Accounting Basics:** • Organize financial plan for new ventures in technopreneurship • Importance of financial plan • Preparing financial statements and capital budgeting in IT Business • Cash flow statements and projection • Income (P&L) statements; accrual accounting, depreciation, operating expense • Balance sheets; equity, liability • Breakeven time	6	2	-	-	8	16
	9.	**Raising Capital:** • Sources: debt and venture capital • Incubators, accelerators • Grants, competitions	2	2	-	-	4	8
	10.	**The Product or Service:** • Core value of product or service • Minimum viable product and iterative design • Cost of goods sold • Product development plan, Gantt chart	3	2	-	-	5	10
	11.	**IT Business Models & Globalization:** • Time value of money • Revenue generation • Price structure; price elasticity • Channels of distribution • Strategic partners • Cultural differences in communication	4	3	-	-	7	14

	12.	**Ethics and social responsibility:** • Ethics. codes of ethics • theoretical frameworks • broader ethical considerations • Ethical issues & Social businesses	2	2	-	-	4	8
		Total	52	28	-	-	80	160

16. **Main references supporting the course:**

- *Start-Up Guide for the Technopreneur: Financial Planning, Decision Making, and Negotiating from Incubation to Exit.*
- Frank Rimalovski, Managing Director of NYU Innovation Venture Fund
- Dave Chapman, Deputy Head of the Department of Management Science and Innovation at UCL (University College London)

<table>
<tr><td>1</td><td colspan="7">Name of Course/Module :DIGITAL FORENSICS</td></tr>
<tr><td>2</td><td colspan="7">Course Code: DFS 232</td></tr>
<tr><td>3</td><td colspan="7">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="7">Rationale for the inclusion of the course /module in the programme:
This course is designed to provide in depth knowledge in computer forensics and explain the objectives of computer forensics.</td></tr>
<tr><td>5</td><td colspan="7">Semester and Year offered: Year 2 Semester 3</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>O</td></tr>
<tr><td></td><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>45</td><td>-</td><td>36</td><td>6</td><td>81</td><td>168</td></tr>
<tr><td>7</td><td colspan="7">Credit Value:4</td></tr>
<tr><td>8</td><td colspan="7">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="7">Course Learning Outcomes:
On completion of this course students will be able to:
• Describe basic concepts on fuse computer network attack analysis with criminal and counterintelligence.
• Outline a range of situations where digital forensics may be applicable.
• Obtain experience with several tools for forensic analysis.
• Recognize the potential sources of digital evidence.</td></tr>
<tr><td>10</td><td colspan="7">Transferable Skills:
• Critical Thinking and Problem Solving Skills
• Information Management and Lifelong Learning</td></tr>
<tr><td>11</td><td colspan="7">Teaching –learning and assessment strategy
• Lectures
• Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer</td></tr>
<tr><td>12</td><td colspan="7">Synopsis:
This course presents an overview of the principles and practices of digital investigation. The objective of this class is to emphasize the fundamentals and importance of digital forensics. This course covers the topics like; Forensic science, regulations, policies & ethics, digital evidence, procedure and methodology.</td></tr>
<tr><td>13</td><td colspan="7">Mode of Delivery:
Lectures, Tutorials, Practical.</td></tr>
</table>

14	**Assessments Methods and Types:** Assignments 20% Mid Exam 20% Final Exam 50% Quiz 10% **Total 100%**
15	**Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Forensic Science:** • Basic concepts on computer forensics, objectives and benefits • Key concepts of enterprise theory of investigation (ETI) • Fuse computer network attack analysis with criminal and counterintelligence investigations and operations • Elements of Crime • Various computer crimes • Types of web attacks • Types of email attacks • Types of network attacks • Mobile based operating systems, their architectures, boot process • Importance of cybercrime investigation • Methodology involved in forensic investigation • Reporting a cyber-crime • Expert witness	10	-	5	-	15	30

	2	**Regulations, Policies and Ethics:** • Searching and seizing computers with and without a warrant • Laws and Acts against Email Crimes • Laws pertaining to Log Management • Policies Pertaining to Mobile Forensics • Laws and Acts against Email Crimes • General Ethics while testifying	7	-	5	-	12	24
	3.	**Digital Evidence:** • Digital Evidence • Types of Digital Evidence • Rules of Evidence • Electronic Evidence; Types and collecting potential evidence • Electronic crime and digital evidence consideration by crime category • Computer forensics Lab • Understanding Hard Disks • Disk Partitions and Boot Process • Understanding File Systems • Windows File Systems • Malware Analysis	8	-	8	-	16	32

	4	**Procedure and Methodology:** • Investigation Computer Crime • Computer Forensics Investigation Methodology • Digital Evidence Examination Process • Encryption • First Responder • Role of First Responder • Network Forensics (Intrusion Detection Systems, IDS)	6	-	6	-	12	24
	5.	**Digital Forensics** • Recover Data • File System Analysis • Windows Forensics • Linux Forensics • Recovering the deleted files and partitions • Application password crackers • Investigating and Analyzing Logs • Investigating Network Traffic • Web Attack Investigation • Cloud Forensics • Malware Forensics	8	-	6	-	14	28

	6.	**Tools/ System Program:** • First Responder Tool Kit • Windows Forensics Tools: Helix3 Pro, X-ways forensics • Data Acquisition Software Tools • Tools to defeat anti forensics • Database Forensics Tools • Password Cracking Tools • Network Forensics Tools • Web Security Tools • Cloud Forensics Tools	6	-	6	-	12	24
		Total	45	-	36	-	81	162

16. **Main references supporting the course:**

- *Practical Guide to digital forensics investigations*, Darren Hayes, Oct 21, 2020
- *Cyber and Digital Forensic Investigations, A law enforcement practitioner's perspective*, Nhien – An Le-Khac, Kim – Kwang Raymond Choo
- *Digital Forensic analysis of smart watches*, phil Scott, Jun 14, 2020
- *Fundamentals of Digital Forensics, theory, methods and real life applications*, joakimkavrestad, May 20, 2020.

<table>
<tr><td>1</td><td colspan="6">Name of Course/Module :CLOUD COMPUTING</td></tr>
<tr><td>2</td><td colspan="6">Course Code: CCP 233</td></tr>
<tr><td>3</td><td colspan="6">Name(s) of academic staff:</td></tr>
<tr><td>4</td><td colspan="6">Rationale for the inclusion of the course /module in the programme:
This course provides a hands-on in depth study of Cloud concepts and capabilities across the various Cloud service models.</td></tr>
<tr><td>5</td><td colspan="6">Semester and Year offered: Year 2 Semester 3</td></tr>
<tr><td rowspan="3">6</td><td rowspan="2">Course Hours</td><td colspan="4">Face to Face</td><td rowspan="2">ILT</td><td rowspan="2">TSLT</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>O</td></tr>
<tr><td>L=Lecture
T=Tutorial
P=Practical
O=Others
TSLT=Total student learning time</td><td>29</td><td>2</td><td>31</td><td>6</td><td>62</td><td>130</td></tr>
<tr><td>7</td><td colspan="6">Credit Value:3</td></tr>
<tr><td>8</td><td colspan="6">Prerequisite: Nil</td></tr>
<tr><td>9</td><td colspan="6">Course Learning Outcomes:
On completion of this course students will be able to:
• Analyze the Functioning of Cloud Computing and Cloud Architecture.
• Demonstrate practical skills onInteroperability- Portability- Integration- Security.
• Solve a real-world problem using cloud computing through group collaboration.</td></tr>
<tr><td>10</td><td colspan="6">Transferable Skills:
• Critical thinking and problem solving skills
• Information Management and Lifelong Learning</td></tr>
<tr><td>11</td><td colspan="6">Teaching –learning and assessment strategy
• Lectures
• Tutorials
At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.</td></tr>
<tr><td>12</td><td colspan="6">Synopsis:
This course introduces the core concepts of cloud computing and helps to gain the foundational knowledge required for understanding cloud computing from a business perspective as also for becoming a cloud practitioner.</td></tr>
<tr><td>13</td><td colspan="6">Mode of Delivery:
Lectures, Tutorials, Practical.</td></tr>
</table>

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Introduction:** • A short history client – server computing • Peer - to - peer Computing • Distributed Computing • Collaborative Computing • Cloud Computing • Functioning of Cloud Computing • Cloud Architecture • Cloud Storage • Cloud Services • Industrial Applications	3	2	-	-	5	10
2	**Business values, introduction:** • Service Modeling • Infrastructure Services • Platform Services • Software Services - Software as service modes- Massively scaled software as a service- Scale of Economy, Management and Administration	2	-	3	-	5	10
3.	**Inside Cloud Computing:** • Feeling Sensational about Organization • Making Strategy Decisions- Governance Issues- Monitoring Business Processes- IT Cost Management	2	-	2	-	4	8

	4	**Cloud Service Administration:** • Service Level Agreements and Monitoring-Support Services-Accounting Services • Resource Management- IT Security- Performance Management- Provisioning-Service Management • Untangling Software Dependencies	2	-	3	-	5	10
	5.	**Cloud Computing Technology:** • Clients - Mobile - Thin - Thick • Security - Data Linkage - Offloading Work - Logging - Forensics - Development - Auditing • Network- Basic Public Internet- The Accelerated Internet- Optimised Internet Overlay- Site-to-Site VPN- Cloud Providers- Cloud Consumers - Pipe Size- Redundancy • Services- Identity- Integration-Mapping- Payments- Search	4	-	4	-	8	16
	6.	**Accessing The Cloud:** • Platforms- Web Application Framework- Web Hosting Services- Proprietary Methods • Web Applications- API's in Cloud Computing, • Browsers for Cloud Computing- Internet Explorer- Mozilla Firefox- Safari- Chrome.	2	-	3	-	5	10
	7.	**Data Management:** • Data Security- Data Location- Data Control- Securing data for transport • Scalability and Cloud Services- Large Scale Data Processing- Databases and Data Stores- Data Archival.	3	-	3	-	6	12

	8.	**Information Storage In Cloud Computing:** • Storage as a Service • Storage Providers- Amazon Simple Storage Service- Nirvanix- Google BigtableDatastore- MobileMe- Live Mesh • Storage Security • Merits and Demerits of Storage	3	-	3	-	6	12
	9.	**Discovery of Private & Hybrid Clouds:** • Need for Privacy- Defining a private cloud- Public • Private and Hybrid Clouds - A Comparison • Examining the Economics of the private cloud- Assessing capital expenditures- Vendor Private Cloud Offerings • The Up Key Vendors- Service Oriented- Systems Integrators- Technology Enablers	4	-	4	-	8	16

	10.	**Cloud Computing Standards:** • Best Practices and Standards • Practical Issues- Interoperability- Portability- Integration- Security • Standards Organizations and Groups- Cloud Security Alliance- Distributed Management Task Force (DMTF)- National Institute of Standards and Technology (NIST)- Open Cloud Consortium (OCC)- Open Grid Forum (OGF)- Object Management Group (OMG)- Storage Networking Industry Association (SNIA)- Cloud Computing Interoperability Forum (CCIF)- Vertical Groups	4	-	6	-	10	20
		Total	29	2	31	-	62	124

16. **Main references supporting the course:**

- "*Cloud Computing: A Hands-On Approach*" by ArshdeepBahga and Vijay Madisetti
- *"Cloud Computing (The MIT Press Essential Knowledge series)"* by Nayan B Ruparelia
- *"Cloud Computing: From Beginning to End"* by Mr Ray J Rafaels
- *"Cloud Computing For Dummies"* by Judith Hurwitz
- *"Cloud Computing for Programmers"* by Daniele Casal

1	**Name of Course/Module :SOFTWARE QUALITY AND TESTING**						
2	**Course Code: SQT 122**						
3	**Name(s) of academic staff:**						
4	**Rationale for the inclusion of the course /module in the programme:** This course explores the goals of quality assurance and quality control activities performed during the life cycle of a software product.						
5	**Semester and Year offered:** Year 2 Semester 3						
6	**Course Hours**	Face to Face				ILT	TSLT
		L	T	P	O		
	L=Lecture T=Tutorial P=Practical O=Others TSLT=Total student learning time	27	2	32	6	61	128
7	**Credit Value:3**						
8	**Prerequisite:** Nil						
9	**Course Learning Outcomes:** On completion of this course students will be able to: • Describe software testing and quality assurance as a fundamental component of software development life cycle. • Obtain relevant information about the scope of SW projects useful for further learning process. • Efficiently perform Testing & QA activities using modern software tools.						
10	**Transferable Skills:** • Communication Skills • Critical Thinking and Problem Solving Skills • Information Management and Life Long Learning						
11	**Teaching –learning and assessment strategy** • Lectures • Tutorials At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.						
12	**Synopsis:** The course module focuses on integrating test processes with established software development methodologies. It further emphasizes on practical exercises to provide students with experience of design, specification, execution of tests plus test automation using tools through a mixture of instructor-directed exercises and student research leading to knowledge sharing.						
13	**Mode of Delivery:** Lectures, Tutorials, Practical.						

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Introduction to software testing:** • Background & Importance of testing • QA as a career • Difference between Project and product • Difference between Quality Assurance and Quality Control • Manual and automation testing • Roles and Responsibilities of Business Analyst, Developers, Architects, Designer (HTML & graphics), Project Managers, Dev-op teams, end users, clients and others	3	2	-	-	5	10
2	**Software Development Life Cycles (SDLC):** • Software Development Life Cycle Stages • Software Development Methodologies • Types of Testing • Risk of inadequate testing • Test Platforms (Development, QC, UAT, Production) • Defects (Identification, Logging, Life Cycle, Priority)	2	-	3	-	5	10

	3.	**Requirement Document:** • Understanding Requirement Documents (SRS,BRD, FRD) • Software Testing Life Cycle (STLC) • System User Manual Doc & Preparation • Release note Doc & preparation • Types of Software Applications, Web applications, Windows-based applications and Intranet applications • Difference between Development, test and production environment	3	-	3	-	6	12
	4	**Bug/Defect/Error:** • What is a Bug? • Difference between Bug and Defect • Defect Management Process • Format of Bug • Priority and Severity • Different status of bug in Bug life cycle	1	-	2	-	3	6

	5.	**Types of Testing & Test Cases:** • Dynamic Testing & Functional Testing • Performance testing Load testing, Stress testing, Soak testing, Spike testing, Scalability testing, Volume testing • Unit Testing, Integration Testing, Regression Testing, Sanity Testing, System Testing, Acceptance Testing, Non-Functional Testing, Compatibility Testing, Data Flow/Control Testing. • Design Testing & Multi Domain testing • Managing Test data & its Importance • Gathering Test Data and its Advantages • Creating Data Repositories	4	-	5	-	9	18
	6.	**Quality Assurance phases & Test plan:** • Phases: Feature Requirement, Test Plan, Test Scenario, Test Cases, Test Data, Test Script, Test Result **Test Plan** • Test Plan & its Contents • Master test plan and testing level test plan • Entry and Exit criteria • Test Coverage & Test Responsibilities • Ad-hoc testing, Exploratory Testing • General risks in test environment	3	-	3	-	6	12

	7.	**Effective QA Communication Skills** • Communicating Bugs • Email Etiquette • Email Etiquette • The Importance of QA Communication Skills • QA Communication and Timing	1	-	2	-	3	6
	8.	**Manual and Automated Testing:** • Automation testing and benefits • Manual VS Automated testing • Automation testing tools and tool selection criteria • Creating and executing basic test, recording, understanding and executing a test **Automation Testing** • Introduction to Selenium • Fundamentals of Selenium, overview, presentation, export features, installation, Selenium IDE and web driver.	2	-	3	-	5	10
	9.	**Test Strategy and Execution:** • Learn Test Execution Life Cycle Process • Understand Different levels of Test Execution • Sanity/ Smoke Testing • Retesting & Regression Testing • what is Bug Leakage	1	-	2	-	3	6

	10.	**API Testing:** • Introduction & Importance • API Testing through Endpoints & Website • Various methods & Types of error codes **POSTMAN Automation** • Using code snippets to automate & save responses • Using Variables in URL, Body parameters to cleanup • Automation using LoadRunner, CSV or json file & Command line • API Automation Test Report Generation • Test Report Analysis	3	-	3	-	6	12
	11.	**Performance Test:** • Performance testing and its importance in QA • Types of Performance Testing & Common Problems • Performance Testing Process & Example Test Cases • Security testing and its importance in QA • Types of Security Testing • Authentication and Authorization • Example Test Scenarios for Security Testing • Methodologies/ Approach / Techniques for Security Testing	2	-	3	-	5	10

	12.	**Mobile Platforms and Testing:** • Types of Mobiles; Android, iOS, Windows7 • Mobile testing and Mobile application testing strategy, how to choose which devices to test, planning what to test and how to review strategy • Unique challenges in mobile application testing • Building a Mobile Testing Strategy • Simulators and Emulators • Beta testing & Live App Testing	2	-	3	-	5	10
		Total	27	2	32	-	61	122

16. **Main references supporting the course:**

- *Daniel Galin, Software Quality Assurance: From Theory to Implementation*, Addison Wesley, 2003.
- *Stephen Kan, Metrics and Models in Software Quality Engineering* (2nd Edition), Addison Wesley, 2002.

Additional references supporting the course:

- *Schulmeyer, G. Gordon and McManus, James, (eds), Handbook of Software Quality Assurance*, 3rd Ed. Prentice Hall, 1999.

1	**Name of Course/Module : SOFTWARE PROJECT MANAGEMENT**						
2	**Course Code: SPM 235**						
3	**Name(s) of academic staff:**						
4	**Rationale for the inclusion of the course /module in the programme:** This module is to prepare students for undertaking large software projects. It introduces the students to the high-level strategies required for managing projects from their genesis to completion.						
5	**Semester and Year offered:** Year 2 Semester 3						
6	**Course Hours**	Face to Face				ILT	TSLT
		L	T	P	O		
	L=Lecture T=Tutorial P=Practical O=Others TSLT=Total student learning time	34	4	24	6	62	130
7	**Credit Value:3**						
8	**Prerequisite:** Nil						
9	**Course Learning Outcomes:** On completion of this course students will be able to: • Describe the basic concepts and scope of software project management. • Identify factors of risk, categorize and prioritize actions for eliminating risk. • Analyse the approaches for managing and optimizing the software development process useful for leading a project.						
10	**Transferable Skills:** • Critical thinking and problem solving skills • Lifelong learning and information management • Leadership skills						
11	**Teaching –learning and assessment strategy** • Lectures • Tutorials At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.						
12	**Synopsis:** The course module is designed to prepare software project managers, novice or experienced, with project management skills needed to better manage software projects. It covers software life cycle process, software life cycle models, software estimation, project planning project monitoring & control.						
13	**Mode of Delivery:** Lectures, Tutorials, Practical.						

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Course Overview Introduction to Software Project Management:** • Importance of software project management • Activities methodologies • Categories of software projects • Setting objectives • Management principles • Management control	3	1	-	-	4	8
2	**Software Life Cycle Process (ISO/IEC 12207):** • Software process and process models • Choice of process models	2	1	-	-	3	6
3.	**Software Life Cycle Models:** • Waterfall Model / Traditional Model • Rapid Application Development • Agile Methods • Extreme Programming • SCRUM • COCOMO Model	3	-	3	-	6	12
4	**Software Estimation:** • Project schedules • Activities • Sequencing and scheduling	2	-	2	-	4	8

	5.	**Project Planning Project Monitoring & Control:** • Strategic program management • Stepwise project planning • A generic project model	2	-	2	-	4	8
	6.	**Risk Management:** • Concepts of risks and risk management • Risk management activities • Network planning models • Critical path methods • Risk identification • Assessment monitoring • PERT Chart	3	-	3	-	6	12
	7.	**Software Measurement**	2	-	2	-	4	8
	8.	**Requirements Management**	2	-	2	-	4	8
	9.	**Software Test Management Verification & Validation:** • Types of software testing • Manual testing • Automated testing • Black box testing • White box testing	3	-	3	-	6	12
	10.	**Software Configuration Management (SCM):** • Centralized control team organization • Decentralized control team organization • Mixed control teamorganization	3	1	-	-	4	8
	11.	**Problem Resolution:** • Project metrics • Earned value analysis	2	-	2	-	4	8

	12.	**Software Quality Assurance (SQA):** • Software qualities • Software quality standards - ISO standards for software organization • Comparison between ISO 9001 & SEI CMM	3	-	3	-	6	12
	13.	**Software Reviews:** • Gantt charts • Automated tools	2	-	2	-	4	8
	14.	**Software Process Improvement:** • Budgeting	2	1	-	-	3	6
		Total	34	4	24	-	62	124

16. **Main references supporting the course:**

- Information Technology Project Management – Providing measurable organizational value by Jack T. Marchewka.

IV SEMSETER

1	**Name of Course/Module :RESEARCH METHODOLOGY**						
2	**Course Code: MCSC 233**						
3	**Name(s) of academic staff:**						
4	**Rationale for the inclusion of the course /module in the programme:** Research Methodology is a hands-on course designed to impart education in the foundational methods and techniques of academic research.						
5	**Semester and Year offered:** Year 2 Semester 4						
6	**Course Hours**	Face to Face				ILT	TSLT
		L	T	P	O		
	L=Lecture T=Tutorial P=Practical O=Others TSLT=Total student learning time	53	9	20	6	82	170
7	**Credit Value:4**						
8	**Prerequisite:** Nil						
9	**Course Learning Outcomes:** On completion of this course students will be able to: • Develop understanding of the basic framework of research process. • Analyse various research designs and techniques in a professional way. • Identify various sources of information for literature review and data collection.						
10	**Transferable Skills:** • Communication Skills • Ethics, Moral and Professionalism • Information Management and Lifelong Learning						
11	**Teaching –learning and assessment strategy** • Lectures • Tutorials At the end of the programme, students are given an opportunity to evaluate the course and the lecturer.						
12	**Synopsis:** The primary objective of this course is to develop a research orientation among the scholars and to acquaint them with fundamentals of research methods. Specifically, the course aims at introducing them to the basic concepts used in research and to scientific social research methods and their approach.						
13	**Mode of Delivery:** Lectures, Tutorials, Practical.						

14 **Assessments Methods and Types:**

Assignments	20%
Mid Exam	20%
Final Exam	50%
Quiz	10%
Total	**100%**

15 **Content Outline of the course/module and the SLT per topic**

No	Subject description	Face to face				ILT	Total
		Lecture	Tutorial	Practical	Others		
1	**Research Methodology: A Review of the Fundamentals:** • Meaning of research • Definitions of research • Objectives of research • Motivation in research • General characteristics of research • Criteria of good research • Types of research	8	2	-	-	10	20
2	**The Research Problem:** • Scientific thinking • What is a research problem? • Selecting the problem • Sources of the problem • Defining a problem • Statement of a problem • Delimiting a problem • Evaluation of a problem	6	2	-	-	8	16
3.	**The Review of Literature:** • Meaning of review of literature • Need of review of literature • Objectives of review of literature • Functions of literature • How to conduct the review of literature? • Some hints for the review of literature • Reporting the review of literature	8	2	-	-	10	20

	4	**The Research Hypothesis:** • Meaning of hypothesis • Definitions of hypothesis • Nature of hypothesis • Functions of hypothesis • Importance of hypothesis • Kinds of hypothesis • Characteristics of a good hypothesis • Variables of a hypothesis • Formulating a hypothesis • Testing the hypothesis	9	-	7	-	16	32
	5.	**The Research Approach:** • The philosophical background • The qualitative approach • The quantitative approach • The mixed methods approach • Criteria for selecting a research approach	6	-	3	-	9	18
	6.	**The Research Strategies:** • What are the research strategies? • Which strategy to choose? • Case studies • Experiments • Ethnography • Phenomenology • Ground theory (GT) • Action research • Mixed methods Longitudinal	8	3	-	-	11	22
	7.	**Data Collection Methods:** • Questionnaires • Interviews • Focus groups • Observation	3	-	4	-	7	14

	8.	**Sampling:** • Meaning & definition of sampling • Functions of population and sampling • Methods of sampling • Characteristics of a good sample • Size of a sample • The sample cycle	5	-	6	-	11	22
		Total	53	9	20	-	82	164

16. **Main references supporting the course:**

- Cohen, L. Lawrence, M., & Morrison, K. (2005). *Research Methods in Education* (5th edition). Oxford: Oxford University Press.
- Denscombes, M. (2010). T*he Good Research Guide: For small-scale social research projects*. Maiden-Read: Open University Press.
- Dornyei, Z. (2007). *Research Methods in Applied Linguistics*. Oxford: Oxford University Press.
- Hoadjli, A.C. (2015). *The Washback Effect of an Alternative Testing Model on Teaching and Learning: An exploratory study on EFL secondary classes in Biskra*. Unpublished Doctoral Thesis, University of Mohamed Kheider, Biskra.

Additional references supporting the course:

- Kumar, R. (2011). *Research Methodology: a step-by-step guide for beginners* (3rd edition). London, UK: TJ International Ltd, Padstow, Corwall.
- Singh, Y. K. (2006*). Fundamental of Research Methodology and Statistics*. New Delhi. New International (P) Limited, Publishers.
- Wallinman, N. (2006). Your Research Project: A step-by-step guide for the first-time researcher. London: Sage Publications.

Research Project

Course Code: MCS 241 **Credit Value:8**

Objectives

The aim of the course is to give the students an opportunity to perform a research project within the field of biomedicine under supervision according to an individual study plan, to summarize the results in a research report and present the results of the project.

Upon completion of the course, the student should be able to:

Regarding knowledge and understanding

- Apply experimental methods to solve a given scientific task.
- Collect data for evaluation and for statistical treatment, if relevant.
- Use relevant scientific literature.

Regarding skills and ability

- Perform a research project according to an individual study plan.
- Show independence, critical and creative thinking.
- Document results by writing a research report.
- Present and discuss the research results with colleagues and senior researchers.
- Formulate new scientific questions that came up during project performance.

Regarding judgements and attitudes

- Show a professional attitude regarding time planning, collaboration, and the link between theoretical and practical knowledge, in a safe manner and in good order to handle scientific material.
- Perform the project work in an ethical correct manner.
- Reflect upon and discuss the relevance of the work in written and oral form.

Content

The course is based on an individual research work including literature studies according to the study plan. An individual study plan will be commonly written by the supervisor and the student which serves as a project description. At the end of the practical work, the students will write a research report. A poster based on the research results will be designed, presented and discussed. Data collection can be performed at other universities or authorities than KarolinskaInstitutet, or in industry.

Teaching methods

Individual work under supervision.Participation in seminars, journal clubs or similar activities in the respective scientific environment. Reading of scientific literature as recommended by the supervisor and the student´s own judgment.

Seminar in Emerging Issues in IT

Course Code: MCS 241 **Credit Value: 3**

Introduction

The MCS program offers some additional courses to provide diverse exposure for students' in contemporary and emerging areas of information technology and computer science through seminar. These courses will be given in the form of seminar and conference.

Today organizations are either embracing digital technologies to improve their businesses or being disrupted by entrants with such capabilities. Therefore, it is important for managers and executives of all organizations to learn about various technologies and apply them in innovative ways. Some of the most important trends in Information Technology are in mobile, cloud, security, and block chains. Using this knowledge of various technologies, IT managers can better overcome technical challenges, evaluate tradeoffs, unlock new revenue streams, and implement change in the organization's Information systems capabilities.

This course has an experiential learning focus, and is conceived to enable students to develop their identities as influential managers and leaders in the IT industry. It is based on the principles that personal growth and sustained development of leadership, technopreneurship and management potential are relational activities, essentially supported by ongoing personal knowledge and understanding. Through a reflective, action learning approach, the course enables students to become aware of themselves, their values and their purpose, and identify their personal development needs and influence their technopreneur and leadership potential.

It connects individual and team based learning and development, and encourages personal development. It enables students to become aware of enablers and barriers to individual, team and organizational success and their relationship to leadership, technopreneurship and management in a global context.

Students will work in purposeful groups, identifying and setting their own targets for development, as individuals and as a reciprocal learning community. They will then devise an agreed vehicle for meeting those targets with their tutor, and report on the progress of their development through a report of assessment tasks.

Course

The seminar course is offered for final Semester students. Broad topics include,

- The broader area of computer and information system,
- Social implications of technology,
- Innovative business models,
- Current trends in computer science and information technology applications and development,

- Professional issues, emerging trends, technologies and current topics in computer science research.

Implementation procedure

The concerned college has to obtain permission from the University before implementing the additional and specialization seminar course. The college has to recommend a course along with detail micro syllabus/activities, program and procedure of conducting seminar and get permission from the University to implement the seminar course(s).

Students will be given 15 days extensive classes on focused topic/syllabus. Finally, student has to prepare a paper in his/her topic assigned by the concerned faculty. The size of the paper should be in between 20 to 30 pages or 3000-3500 words in length. It should be presented in the form of research paper that details the concept, problem, literature, objective(s), design and methods, data, findings and critical analysis, conclusion and recommendations etc. The student will present his/her paper in a seminar organized by the college on the stipulated day in presence of external examiner.

Evaluation

Performance of the student is evaluated on 100 marks. The marks are distribution on the following basis:

Criteria	**Weightage**	**Remarks**
Content of the Paper	50%	Internal and External
Paper Presentation	30%	External
Class Participation	10%	Internal
Faculty Evaluation	10%	Internal

The performance of student will be judged by a panel of three persons comprised with:

- Institutional Head/Principal/Head of School
- Concerned Seminar Faculty Internal expert
- External expert

The marks obtained by the student should be sent to the University along with a copy of the paper prepared by the student and evaluated by the panel of experts for the purpose of recording in the University.