Draft

Information Booklet cum Syllabus

of

'A' Level Course in Information Technology (IT)

Under DOEACC Scheme

Revision-V

MONTH/YYYY

National Institute of Electronics and Information Technology
An Autonomous Scientific Society under
Ministry of Electronics and Information Technology, Government of India
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Section 1

About NIELIT and 'A' Level Course in Information Technology under DOEACC Scheme

1.1. About the Revised Syllabus

The fourth revised version of 'A' Level course in Information Technology syllabus under DOEACC Scheme came into effect in January 2010 examinations. Since then, much advancement has been observed in the area of Information Technology. The need of industry has also changed with the availability of new and advanced technologies and tools. With the advancement in technologies, the software development practices have also changed. This also has led to change in job profile. Different job roles requires different skills. Moreover, the digital initiatives taken by Government have also changed the way the business is taking place these days. These factors have led to bringing the revision in syllabus of DOEACC 'A' Level (IT) course.

This document presents the fifth revised version of DOEACC 'A' Level course in Information Technology syllabus which becomes effective for teaching with immediate effect. The syllabus of 'A' Level course is designed to enhance the skills of students so as to enable them to solve problem using Information Technology (IT) tools. The self-learning approach is built into the syllabus enabling the learners to update themselves on the changing technologies in their area of work.

1.2. About NIELIT

National Institute of Electronics and Information Technology, NIELIT, (Erstwhile DOEACC Society) is an autonomous scientific society of the Ministry of Electronics & Information Technology, Government of India. The Society is registered under the Societies Registration Act, 1860. NIELIT was set up to carry out Human Resource Development and related activities in the area of Information, Electronics & Communications Technology (IECT). NIELIT is engaged both in Formal & Non-Formal Education in the area of IECT besides development of industry-oriented quality education and training programmes in the state-of-the-art areas. NIELIT has endeavoured to establish standards to be the country's premier institution for Examination and Certification in the field of IECT. It is also one of the National Examination Body, which accredits institutes/organizations for conducting courses in IT and Electronics in the non-formal sector.

Over the last three decades, NIELIT has acquired very good expertise in IT training through its wide repertoire of courses. These courses are as under.

- 'O' Level (Foundation) –NSQF aligned course at Level 5
- 'A' Level (Advance Diploma) - NSQF aligned course at Level 6
- 'B' Level (MCA equivalent) - NSQF aligned course at Level 7
- 'C' Level (M-Tech level) - NSQF aligned course at Level 8
- Digital Literacy Courses
    - ACC (Awareness in Computer Concepts)
    - BCC (Basic Computer Course)
    - CCC (Course on Computer Concepts) –NSQF aligned at Level 3
    - CCC+ (Course on Computer Concepts Plus)
    - Expert Computer Course

At present, NIELIT is operating from offices located at Agartala, Aizawl, Ajmer, Aurangabad, Bhubaneswar, Calicut, Chandigarh, Chennai, Chuchuyimlang, Churachandpur, Delhi, Dibrugarh, Gangtok, Gorakhpur, Guwahati, Haridwar, Imphal, Itanagar, Jammu, Jorhat, Kohima, Kolkata, Kokrajhar, Kurukshetra, Leh, Lucknow, Lunglei, Mandi, Pasighat, Patna, Pali, Ranchi, Ropar, Senapati, Shillong, Shimla, Silchar, Srinagar, Tezpur, Tura, Tezu with its Headquarters at New Delhi. It is also well networked throughout India with the presence of about 700 + institutes. The Headquarters is situated at NIELIT Bhawan, Plot No. 3, PSP Pocket, Institutional Area, Sector 8, Dwarka, New Delhi – 110 077.

1.3. DOEACC Scheme

DOEACC was a joint scheme of the Ministry of Electronics & Information Technology, and All India Council for Technical Education (AICTE), Govt. of India.

1.4. Objective of Scheme

The objective of the Scheme is to generate skilled manpower in the area of Information Technology (IT) and Electronics at the national level by utilizing the facilities and infrastructure available with the institutions/organizations in the non-formal sector. NIELIT is managed and administered by a Governing Council which consists of eminent academicians and professionals from IT and Electronics industries. Minister for Electronics & Information Technology, Government of India, is the Chairman of the Governing Council. The Director General is the Chief Executive Officer of the Society and manages day to day affairs of the Society. Manifold functions of the DOEACC Scheme are:

i. Accreditation
ii. Registration
iii. Examination
iv. Certification

1.5. 'A' Level Course in Information Technology under DOEACC Scheme

1.5.1. Objective of 'A' Level Course in Information Technology

The objective of the course is to equip a student with necessary skills as per following job role based on specialisation attained.

i. Freelancer (For self employed)
ii. Full Stack Developer
iii. Data Scientist/Analyst
iv. IoT Architect
v. IoT Developer
vi. Business Intelligence Analyst
vii. Information Security Analyst

1.5.2. Structure of 'A' Level Course in Information Technology under DOEACC Scheme

The revised syllabus (Revision V) of 'A' Level course consists of eight compulsory theory modules. The first four modules are that of all four modules of 'O' Level (IT)

Revision V, six specialized areas (students to pick one specialized area) each consisting of two modules, two practical papers and one project. The structure of the 'A' Level in Information Technology syllabus is indicated below:-

Structure of 'A' Level Course in Information Technology Revision V

1. A1-R5: Information Technology Tools and Network Basics
2. A2-R5: Web Designing & Publishing
3. A3-R5: Programming and Problem Solving through Python
4. A4-R5: Internet of Things and its Applications

} Four modules of 'O' Revision V (Mandatory)

5. A5-R5: Data Structure Though Object Oriented Programming Language
6. A6-R5: Computer Organization and Operating System
7. A7-R5: Database Technologies
8. A8-R5: Systems Analysis, Design and Testing

} Another set of four mandatory modules

For module 9 and 10, student will have to select one specialized group out of six groups.

Each specialized group consists of two modules.

Both the modules within selected specialized group are mandatory to qualify 'A' Level (IT)

Note: Two practical papers, one mini project and one major project in specialized area are mandatory to qualify 'A' Level (IT)

Specialized Area: Data Analytics
A9.1-R5 : Big Data Analytics using Hadoop
A10.1-R5 : Data Science using Python

Specialized Area: Web Application Development
A9.2-R5 : Web Application using PHP
A10.2-R5 : Full Stack Web Application using MVC

Specialized Area: Information Security
A9.3-R5 : Data Communication and Networking
A10.3-R5: Information Security Management

Specialized Area: Internet of Things
A9.4-R5 :Internet of Things (IoT): A Practical Approach
A10.4-R5: Internet of Things (IoT) using Raspberry Pi

Specialized Area: Artificial Intelligence
A9.5-R5 : Artificial Intelligence Concepts and R Programming
A10.5-R5: Artificial Intelligence Using Python

1.5.3. Sequence of Modules Training

The suggestive sequence to cover all the modules of 'A' Level course in Information Technology along with learning hours is listed below.

Module Code	Module	Learning Hours (Theory)	Learning Hours (Practical/ Tutorials/ Project)	Total Learning Hours
Semester I				
A1-R5	Information Technology Tools and Network Basics	48	72	120
A2-R5	Web Designing & Publishing	48	72	120
A6-R5	Computer Organization and Operating System	48	72	120
A7-R5	Database Technologies	48	72	120
Semester II				
A3-R5	Programming and Problem Solving through Python	48	72	120
A4-R5	Internet of Things and its Applications	48	72	120
A5-R5	Data Structure Though Object Oriented Programming Language	48	72	120
A9.X-R5	One module out of A9.1-R5, A9.2-R5, A9.3-R5, A9.4-R5 and A9.5-R5	48	72	120
PR-I	Practical based on A1-R5, A2-R5 , A3-R5 and A4-R5			
PR-II	Practical based on A5-R5, A6-R5 and A7-R5			
PJ-I	Mini Project		50	
Semester III				
A8-R5	Systems Analysis, Design and Testing	48	72	120
A10.X-R5	One module out of A10.1-R5, A10.2-R5, A10.3-R5, A10.4-R5 and A10.5-R5	48	72	120
PJ-II	Major Project (350 hours) based on specialized area.	0	350	350
	Total	**480**	**1110**	**1590**

1.5.4. Sequence of Modules Training After 'O' Level (IT)

The suggestive sequence to cover all the modules of 'A' Level course in Information Technology for those candidates who join 'A' level after passing 'O' Level (IT) course along with learning hours is listed below.

Module Code	Module	Learning Hours (Theory)	Learning Hours (Practical/ Tutorials/ Project)	Total Learning Hours
Semester I				
A5-R5	Data Structure Though Object Oriented Programming Language	48	72	120
A6-R5	Computer Organization and Operating System	48	72	120
A7-R5	Database Technologies	48	72	120
A9.X-R5	One module out of A9.1-R5, A9.2-R5, A9.3-R5, A9.4-R5 and A9.5-R5	48	72	120
PR-II	Practical based on A5-R5, A6-R5 and A7-R5			
Semester II				
A8-R5	Systems Analysis, Design and Testing	48	72	120
A10.X-R5	One module out of A10.1-R5, A10.2-R5, A10.3-R5, A10.4-R5 and A10.5-R5	48	72	120
PJ-II	Major Project (350 hours) based on specialized area.	0	350	350
	Total Learning hours of 'A' Level after 'O' Level (IT)	**288**	**782**	**1070**
	Learning hours for 'O' Level (IT)	**192**	**328**	**520**
	Total	**480**	**1110**	**1590**

List of Specialized Areas	
Data Analytics	
A9.1-R5	Big Data Analytics using Hadoop
A10.1-R5	Data Science using Python
Web Applications	
A9.2-R5	Web Application using PHP
A10.2-R5	Full Stack Web Development using MVC Framework
Information Security	
A9.3-R5	Data Communication and Networking
A10.3-R5	Information Security Management
Internet of Things	
A9.4-R5	Internet of Things (IoT) a Practical Approach
A10.4-R5	Internet of Things (IoT)using Raspberry Pi
Artificial Intelligence	
A9.5-R5	Artificial Intelligence Concepts and R Programming
A10.5-R5	Artificial Intelligence using Python

1.5.5. Duration of the Course

The duration of 'A' level Course in Information Technology is 1200 learning hours and 390 hours of projects. The minimum period to cover contents of 'A' Level Course in Information Technology is one and half year. The minimum period to cover contents of 'A' Level course in Information Technology is one year for those candidates who register themselves in 'A' Level course in Information Technology after passing 'O' Level (IT).

1.6. Practical

The students have to devote 60% of the total time allotted to each module of the course for the practical sessions. Practical assignments have been worked out for each theory module and given in this booklet.

1.7. Improvement

The candidates are allowed to improve his/her grade in one subject immediately after clearing all the theory papers (immediate to last examination where the candidate has cleared his/her last paper).

1.8. Mini Project

The candidate registered in 'A' Level in Information Technology (IT) under DOEACC Scheme is required to submit two projects, one mini project and other major project. Guidelines to submit the Mini project are given in Information Brochure cum Syllabus booklet of 'O' Level (IT) –Revision V under DOEACC Scheme.

1.9. Major Project

NIELIT curriculum has a Major project as an important component of 'A' Level course in Information Technology. The Project is carried out by the student under guidance and support of faculty and management of the respective institute. It is felt that such a project provides an opportunity to the student to apply his/her knowledge and skills to real life problems (including oral and written communication skills), and as such the project should be given utmost importance and priority both by the students as well as institution faculty / management in respect of its identification, planning and implementation.

1.9.1. Objective of the Major Project

The aim of the project is to give the students an integrated experience in solving a real life problem by applying knowledge and skills gained on completion of theory papers in a course at a given Level. IInt provides an occasion for students to develop written and communication skills, Project also helps the students to realize the importance of resource and time management, ownership of task towards deliverables, innovation and efficiency in task management apart from presentation skills. It also provides a good opportunity for students to build, enhance and sustain high levels of professional conduct and performance and evolves a problem solver frame of mind in student. It is also felt that taking up the project by a student prepares him for a job in industry and elsewhere.

1.9.2. Who could be Guide

Who could be a Supervisor / Guide A guide for 'A' Level (IT) should be a person with DOEACC 'B' level/ MCA/ B.Tech/ equivalent/higher qualification and adequate experience (minimum 3 years) in the area in which the student has chosen the Project. In the case of a candidate from an - 5 - accredited institute, the institute concerned will render all help including the nomination of the Supervisor.

1.9.3. Type of Major Project

Student can develop a project of any type like browser based, mobile based or client-server architecture base application. However, it should be based on specialized area which the student has opted. For example, if a student has opted Artificial Intelligence (AI), he/she has to develop a major project in the application areas of AI.

1.9.4. Time of Submission of Major Project for 'A' Level Course in Information Technology

'A' Level (IT) student can submit the project only after clearing 5 papers of the 'A' Level Course in Information Technology and appear in both the modules of specialized area which the student has opted. The project should be of minimum 350 man-hours and carries a total of 100 marks (80% for the project evaluation and 20% for the viva-voce).

1.9.5. Some Important Notes While Preparing the Project Proposal

The following suggested guidelines may be followed in preparing the Final Project Report:
Good quality white executive bond paper A4 size should be used for typing and duplication. Care should be taken to avoid smudging while duplicating the copies.
Page Specification: (Written paper and source code)

- Left margin 3.0 cms Right margin 3.0 cms
- Top margin 2.7 cms
- Bottom margin 2.7 cms
- Page numbers – All text pages as well as Program source code listing should be numbered at the bottom center of the pages.

1.9.6. Submission of Project Report to NIELIT

The student will submit his/her project report in the prescribed format along with requisite fee. The Project Report should include:

- One hard copy of the Project Report.
- Soft copy of Project on Optical Drive
- The Project Report may be about 50 pages (excluding coding).

1.9.7. Fees

An applicable fee for submitting 'A' Level Project should be remitted to NIELIT in the prescribed mode only on the official website of NIELIT. The applicable fee is available on web site on NIELIT. The students are advised to check the applicable fee from official website of NIELIT before remitting the same to NIELIT.

1.9.8. Major Project Submission

The student undergoing course 'A' level Course in Information Technology has to submit project in order to be 'A' Level certified. The project should be original and of real-life value. The project should not be copy of existing material from any other source.

The Learners (Students) are expected to carry out a project successfully and submit the project certificate in the prescribed format from the head of the institute running the accredited course or the organization of which the learner is an employee. Proforma of the Project Completion Certificate is given as follow;

Performa of the Project Completion Certificate

This is to certify that the Project work done by Mr./Ms._____ (NIELIT Registration No._____) in partial fulfilment of 'A' Level Course in Information Technology under DOEACC Scheme Examination at _____ has been found satisfactory.

This report has not been submitted for any other examination and does not form part of any other course undergone by the candidate.

Signature
Name:
(By Head of the Institution) with PROV No. /FULL No.)
Or
Signature
(Name of Head of the Organization / Division)
Division:
Organization Name:
Address:

1.10. Credit Scheme For 'A' Level Course in Information Technology

1.10.1. About Credit System

A credit system based on the AICTE norms has been introduced for indicating the efforts required to pass a specific level of course under the DOEACC Scheme. Award of credit to a student will facilitate measurement/comparison of study hours including Theory Lectures, Tutorials and Practical Assignments put in a given module/paper/subject under the Scheme with similar course in IT in India and abroad. This will also facilitate other Universities/ Apex Accrediting bodies to consider academic and professional equivalence of NIELIT courses. This will also help students/organizations to transfer credits from NIELIT to other academic bodies and vice-versa for ensuring continuity in education. Following table gives the number of hours of theory lectures, tutorials and practicals per week to be attended and the credits earned by the student:-

1.10.2. Calculation of Credits

Sr. No.	Module Code	Module Name	No. of Lecture Theory Hours	No. of Tutorial/ Practical /Project Hours	Theory Credits	Practical Credits	Total Credits
			(A)	(B)	(C=(A)/ 15)	(D= ((B) /2* 15)	(E= (C) + (D))
1.	A1-R5	Information Technology tools and Network Basics	48	72	3	2	5
2.	A2-R5	Web Designing & Publishing	48	72	3	2	5
3.	A3-R5	Programming and Problem Solving through Python	48	72	3	2	5
4.	A4-R5	Internet of Things and its Application	48	72	3	2	5
5.	A5-R5	Data Structure Though Object Oriented Programming Language	48	72	3	2	5
6.	A6-R5	Computer Organization and Operating System	48	72	3	2	5

7.	A7-R5	Database Technologies	48	72	3	2	5
8.	A8-R5	Systems Analysis and Design	48	72	3	2	5
9.	A9.x-R5	One module out of A9.1-R5, A9.2-R5, A9.3-R5, A9.4-R5 and A9.5-R5	48	72	3	2	5
10.	A10.x-R5	One module out of A10.1-R5, A10.2-R5, A10.3-R5, A10.4-R5 and A10.5-R5	48	72	3	2	5
11.	PR-I	Practical-1	-	-	-	-	-
12.	PR-II	Practical-2	-	-	-	-	-
13.	PJ-II	Project		350		12	12
14.		**Total Credits**					**62**

Notes

1. One credit is defined as one hour of theory lecture and 2 hours of tutorials/ practical/project every week for one semester consisting of 15 weeks.
2. Total number of credits earned in a module is calculated using AICTE formula (as applicable to Under Graduate Courses in IT namely C=L + (T+P)/2 where L, T and P indicate number of hours per week for Lectures, Tutorials and Practical. Hours spent during Project development is considered under Tutorials and Practical.
3. The credit scheme has been implemented since July, 2003 examinations.
4. Fractions in Credits have been rounded to nearest integer.

1.11. Examination Pattern

The theory examination for each module under the fifth revised syllabus would be for duration of three hours and the total marks for each subject would be 100. Each Practical examination will be of three hours duration and would carry 100 marks. The teaching and examination for 'A' Level modules in IT will start once the notification is issued by NIELIT.

Dates for the various activities related with examinations will be announced on NIELIT website, well in advance of the examinations.

Laboratory/ Practical work will be conducted at Institutions / organizations, which are running the course. NIELIT will be responsible for holding the examination for theory and practical both for the students from Accredited Centres and student at large.

1.11.1. Pass Percentage

To qualify a module, a candidate must have obtained at least 50% in each theory and practical examination. A successful project complete certificate is mandatory for student to qualify 'A' Level course. Following table shows the marks distribution.

Module Code	Module	Maximum Marks
A1-R5	Information Technology tools and Network Basics	100
A2-R5	Web Designing & Publishing	100
A3-R5	Programming and Problem Solving through Python	100
A4-R5	Internet of Things and its Application	100
A5-R5	Data Structure Through Object Oriented Programming Language	100
A6-R5	Computer Organization and Operating System	100
A7-R5	Database Technologies	100
A8-R5	Systems Analysis and Design	100
A9.x-R5	One module out of A9.1-R5, A9.2-R5, A9.3-R5, A9.4-R5 and A9.5-R5.	100
A10.x-R5	One module out of A10.1-R5, A10.2-R5, A10.3-R5, A10.4-R5 and A10.5-R5.	100
PR-I	Practical-1 (Based on Modules A1-R5 to A4-R5)	100
PR-II	Practical-2 (Based on Modules A5-R5 to A7-R5)	100
PJ-I	Mini Project	100
PJ-II	Major Project based on Specialized Areas	200
	Total	1500

The marks will be translated into grades, while communicating results to the candidates. The gradation structure is as below: -

Pass Percentage	Grade
Failed (<50)	F
50%-54.99%	D
55%-64.99%	C
65%-74.99%	B
75%-84.99%	A
85% and over	S

1.10.1. Award of Certificates

The students would be eligible for the award of 'A' Level course in Information Technology under DOEACC Scheme certificate on successfully qualifying the eligibility criteria along with Theory Examinations of all modules, Practical Examination and the Project. The 'A' Level Certificate was recognized as equivalent to Advance Diploma

Level Course by the Government of India for the purpose of employment vide Notification No. F.18-23/92-TD.V/TS dated 1st March, 1995 and F.18-23/92-TD.V/TS-IV dated 10th April, 1996 issued by Ministry of Human Resources Development and is currently aligned at NSQF (National Skill Qualifications Framework) level 6. Further, in the certificate, the specialized area will also be mentioned.

Student after clearing all the 10 modules, two projects and two practical examinations has further option to appear in additional specialized area. The students interested in getting certificate of additional specialized area shall have to clear both the modules of additional specialized area. Such students are also required to submit a major project related to additional specialized area.

Student who is registered in 'A' Level Course in Information Technology and clears first four modules (A1-R5, A2-R5,A3-R5 and A4-R5), Practical, PR-1 and submits mini project certificate as per requirement of 'O' Level (IT) will be awarded 'O' Level (IT) certificate provided he/she is eligible for registering in 'O' Level (IT).

1.10.2. Registration

Registration is a pre-requisite for appearing in 'A' Level examinations. A candidate can register at only one level at a time to appear for the examination. Registration is only for candidates and not for institutes. Candidate has to register with NIELIT through online portal.

1.10.3. Eligibility Criteria

The eligibility criteria for registration at 'A' Level are as follows:

(i.) Students from Institutes conducting accredited courses:

'O' Level in Information Technology under DOEACC Scheme. Such candidates are required to register through NIELIT 'A' Level Accredited institute.

Or

A Government recognized polytechnic engineering diploma after 10+2/ Graduate (may be concurrent). Such candidates are required to register through NIELIT 'A' Level Accredited institute.

Or

10+2. Such candidates are required to register through NIELIT 'A' Level Accredited institute. Candidates can pursue graduation in parallel with 'A' level (IT) Course. The candidate will be eligible for getting O Level (IT) certificate after clearing required modules.

In each of the above cases, the completion certificate of 'A' Level under DOEACC Scheme will be awarded only after successful completion of the academic stream i.e. polytechnic engineering diploma after 10+2 or degree (Graduation).

(ii.) Direct Applicants

'O' Level in Information Technology under DOEACC Scheme followed by six month experience in IT. Relevant experience connotes job experience in IT, including teaching in a recognized institution as a faculty member, excludes coaching.

Or

A Government recognized polytechnic engineering diploma after 10+2/ Graduate (may be concurrent) followed by one and half year experience in IT. Relevant experience connotes job experience in IT, including teaching in a recognized institution as a faculty member, excludes coaching.

Or

10+2. Candidates can pursue graduation in parallel with 'A' level (IT) Course followed by one and half year experience in IT. Relevant experience connotes job experience in IT, including teaching in a recognized institution as a faculty member, excludes coaching. The candidate will be eligible for getting O Level (IT) certificate after clearing required modules.

In each of the above cases, the completion certificate of 'A' Level under DOEACC Scheme will be awarded only after successful completion of the academic stream i.e. polytechnic engineering diploma after 10+2 or degree (Graduation).

1.10.4. Prior Knowledge for Selecting Specialized Area

In 'A' Level Course in Information Technology under DOEACC Scheme, five specialized areas are offered. The student has to select one. Each specialized area requires certain level of prior knowledge. The following table shows the recommended prior knowledge before selecting the specialized area. However, it is not essential.

Sr. No.	Specialized Area	Recommended Prior Knowledge
1	Data Analytics	Mathematics / Statistics
2	Web Application Development	HTML and/or any client-side scripting
3	Information Security Management	Computer Network Concepts
4	Artificial Intelligence	Mathematics/ Statistics/ Business Intelligence/ Data Mining
5	Internet of Things (IoT)	Science subjects

1.10.5. Schedule of Registration of 'A' Level Course in Information Technology

For getting registered, a candidate fulfilling the eligibility criteria should apply online through NIELIT portal. Registration fee is also to be paid online. Registration fee once paid is not reimbursable or adjustable against any other payment.

Registration Application can be submitted online throughout the year, however cut off dates are specified for submitting Registration Application for each examinations for the convenience of processing and allotting Registration Numbers.

Cut off Dates Registration			
January Examination		**July Examination**	
Direct Candidate	**Through Institute**	**Direct Candidate**	**Through Institute**
30th September of previous year	10th October of previous year	31st March of same year	10th April of same year

1.10.6. Auto-upgradation:

The candidates successfully completing all papers (Theory, Practical and Project) of a particular Level in a particular Examination and wish to appear in the next Examination for immediate higher Level are exempted from the above cut off dates. Such candidates can fill up examinations Form and Registration Forms for higher Levels subject to following conditions: -

a) Combined Registration fee and Examination fee is paid online.

b) The facility is available to the candidates appearing through Accredited Institutes and not for direct applicants. However, the facility is available to a candidate who might have completed lower level as a direct candidate and wishing to appear for immediate higher level through Accredited Institutes.

c) The facility is also not available to those candidates who might be appearing through Accredited institute but have cleared lower level prior to the preceding exam (e.g. if a candidate has passed 'A' Level Exam in Jan, 2019, he would be eligible for this facility in case he wishes to appear for 'B' Level Examinations in July, 2019 through Accredited Institute. If, however, he had passed 'A' Level prior to Jan., 2019 Exams, this facility would not be available to him).

d) This facility would also not be available to the candidate opting for Level jumping (e.g. from 'O' to 'B' or 'A' to 'C' Levels).

Once registered at a particular level, the registration is valid for ten consecutive examinations for 'A' Level, reckoned from the specific examination as indicated in the Registration allocation letter issued to the candidates.

Registration, by itself, does not entitle a candidate to appear for an examination at the Level concerned, unless all conditions, stipulated in the examination application form, and in any other notification, relevant to the examination are fulfilled by the candidate.

1.10.7. Re-registration:

Candidates who are not able to clear the level within the validity period of initial registration, are allowed to re-register for once, at the same level for another full term i.e. 5 years to clear the left over papers by submitting filled in Registration application and full Registration fee within one year of the expiry of the validity period of existing Registration.

1.12. Practical Examination Scheme

The Practical Examination will be conducted by the NIELIT in reputed Institutions for all candidates. The institutes are obliged to facilitate the conduct of Practical Examinations and arrange infrastructure, support of its faculty and staff for the conduct of Practical Examination at their Centre. The practical examination scheme is as follows.

Number of Practical Examination	Three
Duration of Practical Examination	Three-hour duration including viva-voce
Max. Marks	100 = 80(Practical) + 20(Viva Voce)
Grading	Marks obtained by the students will be translated into the Grades as per the structure given Section 10.1.
Date(s)	Date(s) for practical examination will be announced on NIELIT website.

The institutes are not allowed to charge any fee from the candidates for the practical examination.

1.13. Parity Table Between Revision IV And Revision V Of 'A' Level Course in Information Technology

Previous Syllabus		**Revised Syllabus**	
Module Code (Revision IV)	**Revision IV (Module)**	**Module Code (Revision V)**	**Revision V (Module)**
M1/A1-R4	IT Tools and Business System	A1-R5	Information Technology tools and Network Basics
M1/A2-R4	Internet Technology and Web Design	A2-R5	Web Designing & Publishing
M1/A3-R4	Programming and Problem Solving Through 'C' Language	A3-R5	Programming and Problem Solving through Python
M4.1-R4	Application of .NET Technology	A4-R5	Internet of Things and its Applications
M4.2-R4	Introduction to Multimedia		

M4.3-R4	Introduction to ICT Resources		
A4-R4	Computer System Architecture		
A5-R4	Structured Systems Analysis and Design	A8-R5	Systems Analysis, Design and Testing
A6-R4	Data Structure through C Language	A5-R5	Data Structure Through Object Oriented Programming Language
A7-R4	Introduction to Database Management	A7-R5	Database Technologies
A8-R4	Basics of OS, Unix and Shell Programming	A6-R5	Computer Organization and Operating System
A9-R4	Data Communication and Network	No exemption will be given if exemption is already availed for eight mandatory papers (A1-R5 to A8-R5). However, any paper can be exempted against these papers for which exemption has not been availed. Total papers to be exempted shall remain 8.	
A10.1-R4	Introduction to Object Oriented Programming Through Java		
A10.2-R4	Software Testing and Quality Management		

1. The above table shows the equivalence between the modules of old syllabus and revised syllabus (Revision IV and V).
2. Candidates would not be allowed to appear in the equivalent papers of the Revision V (new syllabus), if they have already passed the relevant papers in earlier revision.
3. Candidates would have to pass a total of 10 papers, successfully completed project and pass two practical papers in order to qualify 'A' Level (IT) in Revision V syllabus.
4. In case, the candidate has cleared examination as per Revision II and/or Revision III, the equivalency of Revision II with III and Revision III with IV will be done before the equivalency with Revision V is done.
5. Candidates would be allowed exemption in maximum eight papers which they have passed in Revision IV.
6. No exemption will be given in modules of any specialized area. Candidate will have to appear in examination of modules of specialized area in order to qualify for 'A' Level course in Information Technology.

Section 2

Detailed Information of Modules of 'A' Level Course in Information Technology

2.1. Module: A1-R5- Information Technology Tools and Network Basics

2.1.1.Introduction

The module is designed to equip a student to use computers for professional as well as day to day use. It provides theoretical background as well as in depth knowledge of Software/ packages.

2.1.2.Objectives

After completing the module, the incumbent will be able to:

- Acquire confidence in using computers in Office and General Life
- Identify the basic components of computers and terminology
- Understand file management
- Create documents using word processor, spreadsheet & presentation software
- Understand computer networks, and browse the internet, content search, email and collaborate with peers
- Use e-Governance applications; and use computer to improve existing skills and learn new skills
- Understanding Social Networking platform
- Using internet for Digital Financial services
- Develop knowledge about FutureSkills
- Understand the various financial services and be aware of the various schemes started by Government.

2.1.3.Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.1.4.Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Introduction to Computer	4	6	After completion of this unit of module, the Learner will be able to • Identify computers, IT gadgets and explain their

			evolution and applications. • Get familiar with various input, output and hardware components of a computer along with storage devices. • Get familiar with various types of software, utilities used for computer and mobile apps.
2. Introduction to Operating System	4	6	After learning this unit, Learner will be: • Well acquainted with Operating System and its applications for both desktop and mobile devices. • Able to identify various desktop screen components and modify various properties, date, time etc. • Able to add and remove new program and features, manage files and folders. • Well versed with printing and know various types of file extensions.
3. Word Processing	6	9	After completion of this unit, Learner will have in depth knowledge of • Word Processing, their usage, details of word processing screen. • Opening, saving and printing a document including pdf files. • Document creation, formatting of text, paragraph and whole document. • Inserting Header and Footer on the document. • Finding text on a word document and correcting spellings. • Inserting and manipulating tables, enhancing table using borders and shading features.

			• Preparing copies of a document labels etc. for sending various recipients using Mail Merge.
4. Spreadsheet	8	12	After completion of this unit, Learner will have good hands-on practice on • Basic Knowledge of Spreadsheet Processing, their usage, details of Spreadsheet screen. • Opening, saving and printing a Spreadsheet. • Spreadsheet creation, inserting and editing data in cells, sorting and filtering of data. • Inserting and deleting rows /columns. • Applying basic formulas and functions. • Preparing chart to represent the information in a pictorial form.
5. Presentation	6	9	After completion of this unit, Learner will have good hands-on practice on • Basic Knowledge of PowerPoint presentations. • Opening/saving a presentation and printing of slides and handouts. • Manipulating slides to enhance the look of the slides as well as whole presentation by inserting a picture, objects, multimedia formatting etc. • Running a slide show with various transitions.
6. Introduction to Internet and WWW	6	9	After completion of this unit, Learner will be able to • Gather knowledge of various types of networks and topologies • Get an overview of Internet,

			its applications and various browsers available to access the Internet. • Connect to Internet using various modes of connections/devices available. • Get knowledge of device identification on local network as well as on Internet for both Desktop and Mobile Devices. • Can search Information on the Internet on various topics. • Download and print web pages.
7. E-mail, Social Networking and e-Governance Services	6	9	After completion of this unit, Learner will be able to • Create an email account, compose an email, reply an email and send the email along with attachments • Get familiar with Social Networking, Instant Messaging and Blogs. • Get familiar with e-Governance Services, e-Commerce and Mobile Apps.
8. Digital Financial Tools and Applications	4	6	After completion of this unit, Learner will be able to • Know the Digital Financial Tools. • Get Knowledge of Internet Banking Modes. • Get familiar with e-Governance Services, e-Commerce and Mobile Apps. • Use the Digital Locker and will be able to store documents in Digital Locker.

9. Overview of FutureSkills & Cyber Security	4	6	After completion of this unit, Learner will be familiar with the • Latest trends and technologies in upcoming fields in IECT. • Need of Cyber Security and will be able to secure their PC and Mobile devices by using basic security features.

2.1.5.Marks Distribution

Module Unit	Written Marks (Max.)
1. Introduction to Computer, Introduction to Operating System	10
2. Word Processing	20
3. Spreadsheet	20
4. Presentation	20
5. Introduction to Internet and WWW, E-mail, Social Networking and e-Governance Services	20
6. Digital Financial Tools and Applications, Overview of FutureSkills & Cyber Security	10
7. Total	100

2.1.6.Detailed Syllabus

(i) Introduction to Computer

Computer and Latest IT gadgets, Evolution of Computers & its applications, IT gadgets and their applications, Basics of Hardware and Software, Central Processing Unit, Input devices, Output devices, Computer Memory & storage, Application Software, Systems Software, Utility Software, Open source and Proprietary Software, Mobile Apps.

(ii) Introduction to Operating System

Operating System, Basics of Operating system, Operating Systems for Desktop and Laptop, Operating Systems for Mobile Phone and Tablets, User Interface for Desktop and Laptop, Task Bar, Icons & shortcuts, Running an Application, Operating System Simple Setting, Using Mouse and Changing its Properties, Changing System Date and Time, Changing Display Properties, To Add or Remove Program and Features, Adding, Removing & Sharing Printers, File and Folder Management, Types of file Extensions.

(iii) Word Processing

Word Processing Basics, Opening Word Processing Package, Title Bar, Menu Bar, Toolbars & Sidebar, Creating a New Document, Opening and Closing Documents, Opening Documents, Save and Save As, Closing Document, Using The Help, Page Setup, Page Layout, Borders, Watermark, Print Preview, Printing of Documents, PDF file and Saving a Document as PDF file, Text Creation and manipulation, Document Creation, Editing Text, Text Selection, Cut, Copy and Paste, Font, Color, Style and Size selection, Alignment of Text, Undo & Redo, AutoCorrect, Spelling & Grammar, Find and Replace, Formatting the Text, Creating and using user defined Styles, Paragraph Indentation, Bullets and Numbering, Change case, Header & Footer, Table Manipulation, Insert & Draw Table, Changing cell width and height, Alignment of Text in cell, Delete / Insertion of Row, Column and Merging & Splitting of Cells, Border and Shading, Mail Merge, Table of Contents, Indexes, Adding Comments, Tracking changes, Macros

(iv) Spreadsheet

Elements of Spread Sheet, Creating of Spread Sheet, Concept of Cell Address [Row and Column] and selecting a Cell, Entering Data [text, number, date] in Cells, Page Setup, Printing of Sheet, Saving Spreadsheet, Opening and Closing, Manipulation of Cells & Sheet, Modifying / Editing Cell Content , Formatting Cell (Font, Alignment, Style), Cut, Copy, Paste & Paste Special, Changing Cell Height and Width, Inserting and Deleting Rows, Column, AutoFill, Sorting & Filtering, Freezing panes, Formulas, Functions and Charts, Using Formulas for Numbers (Addition, Subtraction, Multiplication & Division), AutoSum, Functions (Sum, Count, MAX, MIN, AVERAGE),Sort, Filter, Advanced Filter, Database Functions (DSUM, DMIN,DMAX, DCOUNT, DCOUNTA), What-if Analysis, Pivot table Charts (Bar, Column, Pie, Line), Data Validation.

(v) Presentation

Creation of Presentation, Creating a Presentation Using a Template, Creating a Blank Presentation, Inserting & Editing Text on Slides, Inserting and Deleting Slides in a Presentation, Saving a Presentation, Manipulating Slides, Inserting Table , Adding ClipArt Pictures, Inserting Other Objects, Resizing and Scaling an Object, Creating & using Master Slide, Presentation of Slides , Choosing a Set Up for Presentation, Running a Slide Show, Transition and Slide Timings, Automating a Slide Show, Providing Aesthetics to Slides & Printing, Enhancing Text Presentation, Working with Color and Line Style, Adding Movie and Sound, Adding Headers, Footers and Notes, Printing Slides and Handouts

(vi) Introduction to Internet and WWW

Basic of Computer Networks, Local Area Network (LAN), Wide Area Network (WAN), Network Topology , Internet, Concept of Internet & WWW, Applications of Internet, Website Address and URL, Introduction to IP

Address, ISP and Role of ISP, Internet Protocol, Modes of Connecting Internet (HotSpot, Wifi, LAN Cable, BroadBand, USB Tethering), Identifying and uses of IP/MAC/IMEI of various devices, Popular Web Browsers (Internet Explorer/Edge, Chrome, Mozilla Firefox, Opera etc.), Exploring the Internet , Surfing the web, Popular Search Engines, Searching on Internet, Downloading Web Pages, Printing Web Pages

(vii) E-mail, Social Networking and e-Governance Services

Structure of E-mail, Using E-mails, Opening Email account, Mailbox: Inbox and Outbox, Creating and Sending a new E-mail, Replying to an E-mail message, Forwarding an E-mail message, Searching emails, Attaching files with email, Email Signature, Social Networking & e-Commerce, Facebook, Twitter, Linkedin, Instagram, Instant Messaging (Whatsapp, Facebook Messenger, Telegram), Introduction to Blogs, Basics of E-commerce, Netiquettes, Overview of e-Governance Services like Railway Reservation, Passport, eHospital [ORS], Accessing e-Governance Services on Mobile Using "UMANG APP", Digital Locker

(viii) Digital Financial Tools and Applications

Digital Financial Tools, Understanding OTP [One Time Password]and QR [Quick Response] Code, UPI [Unified Payment Interface], AEPS [Aadhaar Enabled Payment System], USSD[Unstructured Supplementary Service Data], Card [Credit / Debit], eWallet, PoS [Point of Sale], Internet Banking, National Electronic Fund Transfer (NEFT), Real Time Gross Settlement (RTGS), Immediate Payment Service (IMPS), Online Bill Payment

(ix) Overview of Futureskills and Cyber Security

Introduction to Internet of Things (IoT), Big Data Analytics, Cloud Computing, Virtual Reality, Artificial Intelligence, Social & Mobile, Blockchain Technology, 3D Printing/ Additive Manufacturing, Robotics Process Automation, Cyber Security, Need of Cyber Security, Securing PC, Securing Smart Phone

2.1.7.Recommended Books/Study Material

1. LibreOffce, Getting Started Guide by LibreOffice Documentation Team
2. MicroSoft Office for Dummies by Wallace Wang
3. Mastering MS Office by Bittu Kumar, V & S Publisher
4. Mastering Office 2016 by Lalit Mali, Notion Press
5. Computer Networking by Tittel Ed, McGRaw Hills Companies
6. OpenOffice.org for DUMMIES by Gurdy Leete, Ellen Finkelstein and Mary Leete

2.2. Module: A2-R5- Web Designing & Publishing

2.2.1.Introduction to Module

This module is designed to start web designing, irrespective of knowledge currently the students have in this area. The businesses, nowadays, are heavily relying on web based applications. The purpose of this module is to provide skill to students in designing layouts of web sites. By the end of this module, students will be able to describe the structure and functionality of the World Wide Web, create web pages using a combination of HTML, CSS, and JavaScript and Angular js. The students will also learn how to design and integrate multimedia objects in web site. Further, the student will learn how web sites are published.

2.2.2.Objective

After completing the module, the incumbent will be able to:

- Design and create effective web pages
- Integrate graphics in web pages
- Integrate various tools and techniques like HTML, CSS, JavaScript etc.
- Design and edit images using tools
- Embed the images in web pages

2.2.3.Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.2.4.Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Introduction to Web Design	2	3	After completing this unit, Learner will be able to • Know the types of web site. • Know the role of front end and back end application. • Understand the concept of client side scripting and server side scripting
2. Editors	2	3	After completing this unit, learner will be able to • Use different editors available for writing code. • Understand working of editors.
3. HTML Basics	10	15	After completing this unit,

			Learner will be able to develop static website using different HTML Controls.
4. Cascading Style Sheets (CSS)	10	15	After completing this unit, Learner will be able to understand the • Purpose of CSS. • Role of CSS in web sites. • Roles of effects in Web site.
5. CSS Framework	6	9	After completing this unit, Learner will be able to use CSS Framework to develop web site effectively.
6. JavaScript and Angular Js	10	15	After completing this unit, Learner will be able to • Apply client side scripting. • Adding validations and checks on forms (web pages).
7. Photo Editor	6	9	After completing this unit, Learner will be able to edit images and embed in web pages.
8. Web Publishing and Browsing	2	3	The Learner will finally be able to publish the web sites.

2.2.5.Marks Distribution

Module Unit	Written Marks (Max.)
1 Introduction to Web Design and Editors, HTML Basics	25
2 Cascading Style Sheets (CSS)	20
3 CSS Framework	15
4 JavaScript and Angular Js	20
5 Photo Editor, Web Publishing and Browsing	20
6 Total	100

2.2.6.Detailed Syllabus

(i) Introduction to Web Design

Introduction of Internet, WWW, Website, Working of Websites, Web pages, Front End, Back End, Client and Server Scripting Languages, Responsive Web Designing, Types of Websites (Static and Dynamic Websites).

(ii) Editors

Downloading free Editors like Notepad++, Sublime Text Editor, Making use of Editors, File creation and editing, saving.

(iii) HTML Basics

HTML: Introduction, Basic Structure of HTML, Head Section and Elements of Head Section, Formatting Tags: Bold, Italic, Underline, Strikethrough, Div, Pre Tag Anchor links and Named Anchors ImageTag, Paragraphs, Comments, Tables: Attributes –(Border, Cellpadding, Cellspacing , height , width), TR, TH, TD, Rowspan, Colspan Lists : Ordered List , Unordered List , Definition List, Forms, Form Elements, Input types, Input Attributes, Text Input Text Area, Dropdown, Radio buttons , Check boxes, Submit and Reset Buttons Frames: Frameset, nested Frames.
HTML 5 Introduction, HTML5 New Elements: Section, Nav, Article, Aside, Audio Tag, Video Tag, HTML5 Form Validations: Require Attribute, Pattern Attribute , Autofocus Attribute, email, number type, date type , Range type, HTML embed multimedia, HTML Layout, HTML Iframe

(iv) CSS

Introduction to CSS, Types of CSS, CSS Selectors : Universal Selector ,ID selector, Tag Selector, Class Selector, Sub Selector, Attribute Selector, Group Selector, CSS Properties: Back Ground properties, Block Properties, Box properties, List properties, Border Properties, Positioning Properties, CSS Lists CSS Tables, CSS Menu Design CSS Image Gallery,

(v) CSS Framework

Web Site Development using W3.CSS Framework, W3.CSS Intro, W3.CSS Colors, W3.CSS Containers, W3.CSS Panels, W3.CSSBorders, W3.CSSFonts, W3.CSS Text, W3.CSS Tables, W3.CSS List, W3.CSSImages, W3.CSS Grid

(vi) JavaScript and Angular Js

Introduction to Client Side Scripting Language, Variables in Java Script, Operators in JS, Conditions Statements, JS Popup Boxes, JS Events, Basic Form Validations in JavaScript. Introduction to Angular JS: Expressions, Modules and Directives.

(vii) Photo Editor

Features of Photo Editing: Tools: Selection Tools, Paint Tools, Transform Tools, Text Tool, Layers, Brightness/ Contrast, Improve Colors and tone, Filters.

(viii) Web Publishing and Browsing

Overview, SGML (Standard Generalized Markup Language), Web hosting Basics, Documents Interchange Standards, Components of Web Publishing, Document management, Web Page Design Considerations and Principles, Search and Meta Search Engines, WWW, Browser, HTTP, Publishing Tools.

2.2.7.Recommended Books/Study Material

1. HTML5, Black Book, Kagent Learning Solution Inc, 2014
2. Mastering HTML, CSS & JavaScript Web Publishing by Lemay Laura, BPB publications
3. HTML & CSS: The Complete Reference by Thomas Powell
4. Web Design, McGraw -hill

2.3. Module: A3-R5- Programming and Problem Solving though Python Language

2.3.1.Introduction to Module

Python is easy to use, powerful and versatile programming language, making it a great choice for developers. Python is used widely in different areas likes building Raspberry Pi applications, writing script program for desktop applications, configuring servers, developing machine learning & data analytics applications and developing web applications.

2.3.2.Objectives

The objectives of this module are to make the learners understand the programming language concepts like Data Types, Loops, Functions; Python Lists, Strings, Tuples, Dictionaries, Elementary Data Handling using Pandas, NumPy etc.

After completion of this course, the learner is expected to analyze the real life problem and write a program in Python to solve the problem. The main emphasis of the module will be on writing algorithm to solve problems and implement in Python. After completion of the module, the learner will be able to

- Draw flow charts for solving different problems
- Develop efficient algorithms for solving a problem
- Use the various constructs of Python viz. conditional, iteration
- Write programs making judicious use of Lists, Strings, Tuples, Dictionaries wherever required
- Manage data using NumPy
- Handle files and create Modules in Python

2.3.3.Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.3.4.Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Introduction to Programming	2	3	After completion of this unit of module, Learner will be able to • Understand the concept of Programming. • Understand evolution of Programming.
2. Algorithm and Flowcharts to solve problems	6	9	After completion of this unit of module, Learner will be able to • Understand the concepts and

			purposes of algorithm and flowchart. • Use algorithm and flowchart to solve problem independent of language. • Gain knowledge of different constructs of algorithm and flowchart.
3. Introduction to Python	2	3	After completion of this unit of module, candidate will be able to • Understand features of Python that make it one the most popular languages in the industry. • Understand structure of Python problem. • Understand the areas where Python is used.
4. Operators, Expressions and Python Statements	10	15	After completion of this unit of module, Learner will be able to • Use the basic operators and expressions available in Python in developing program. • Understand and use various Python statements like conditional constructs, looping constructs in writing Python program.
5. Sequence data types	6	9	After completion of this unit of module, Learner will be able to • Work with various built-in Sequence datatypes and their use • Understand the concept of mutable and immutable objects
6. Functions	10	15	After completion of this unit of module, Learner will be able to • Apply the in-built functions available in Python in solving different problems. • Work with modular approach using user defined

			functions.
7. File Processing	6	9	After completion of this unit of module, Learner will be able to work with files and reading /writing onto files.
8. Modules	2	3	After completion of this unit of module, Learner will be able to • Understand the concept of modules and importing, loading and reloading of modules in programs.
9. NumPy Basics	4	6	After completion of this unit of module, Learner will be able to • Work on NumPy array manipulation to access data and subarrays and to split, reshape, join arrays etc
Total	48	72	

2.3.5.Marks Distribution

Module Unit	Written Marks (Max.)
1. Introduction to Programming, Algorithm and Flowcharts to solve problems	20
2. Introduction to Python, Operators, Expressions and Python Statements, Sequence data types	30
3. Functions, File Processing, Modules	40
4. NumPy Basics	10
5. Total	100

2.3.6.Detailed Syllabus

(i) Introduction to Programming

The basic Model of computation, algorithms, flowcharts, Programming Languages, compilation, testing & debugging and documentation.

(ii) Algorithms and Flowcharts to Solve Problems

Flow Chart Symbols, Basic algorithms/flowcharts for sequential processing, decision based processing and iterative processing. Some examples like: Exchanging values of two variables, summation of a set of numbers, Decimal Base to Binary Base conversion, Reversing digits of an integer, GCD (Greatest Common Division) of two numbers, Test whether a number is prime, factorial

computation, Fibonacci sequence, Evaluate 'sin x' as sum of a series, Reverse order of elements of an array, Find largest number in an array, Print elements of upper triangular matrix, etc.

(iii) Introduction to Python

Python Introduction, Technical Strength of Python, Introduction to Python Interpreter and program execution, Using Comments, Literals, Constants, Python's Built-in Data types, Numbers (Integers, Floats, Complex Numbers, Real, Sets), Strings (Slicing, Indexing, Concatenation, other operations on Strings), Accepting input from Console, printing statements, Simple 'Python' programs.

(iv) Operators, Expressions and Python Statements

Assignment statement, expressions, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Conditional statements: if, if-else, if-elif-else; simple programs, Notion of iterative computation and control flow –range function, While Statement, For loop, break statement, Continue Statement, Pass statement, else, assert.

(v) Sequence Data Types

Lists, tuples and dictionary, (Slicing, Indexing, Concatenation, other operations on Sequence data type), concept of mutability, Examples to include finding the maximum, minimum, mean; linear search on list/tuple of numbers, and counting the frequency of elements in a list using a dictionary.

(vi) Functions

Top-down approach of problem solving, Modular programming and functions, Function parameters, Local variables, the Return statement, DocStrings, global statement, Default argument values, keyword arguments, VarArgs parameters.

Library function-input(), eval(),print(), String Functions: count(), find(), rfind(), capitalize(), title(), lower(), upper(), swapcase(), islower(), isupper(), istitle(), replace(), strip(), lstrip(), rstrip(), aplit(), partition(), join(), isspace(), isalpha(), isdigit(), isalnum(), startswith(), endswith(), encode(), decode(), String: Slicing, Membership, Pattern Matching, Numeric Functions: eval(), max(), min(), pow(), round(), int(), random(), ceil(), floor(), sqrt(), Date & Time Functions, Recursion.

(vii) File Processing

Concept of Files, File opening in various modes and closing of a file, Reading from a file, Writing onto a file, File functions-open(), close(), read(), readline(),readlines(),write(), writelines(),tell(),seek(), Command Line arguments.

(viii) Scope and Modules

Scope of objects and Names, LEGB Rule Module Basics, Module Files as Namespaces, Import Model, Reloading Modules.

(ix) NumPy Basics

Introduction to NumPy ,ndarray, datatypes, array attributes, array creation routines, Array From Existing Data, Array From Numerical Ranges, Indexing & Slicing.

2.3.7.Recommended Books/Study Material

1. Python Programming- A modular Approach (with Graphics, database, Mobil and Web Applications by Sheetal Taneja and Naveen Kumar, Pearson.
2. Python Network Programming Cookbook by Pradeeban Kathiravelu, Dr. M. O. Faruque Sarkar, PACKT.
3. Head First Python by Paul Berry, O'Reilly
4. Dive into Python by Mark Pilgrim, APress
5. Beginning Programming with Python Dummies by John Paul Meuller.

2.4. Module: A4-R5- Introduction to Internet of Things(IoT) and its Applications

2.4.1.Introduction

The module is designed to equip the students to understand the basics of connected world that is Internet of Things (IoT) and its applications. IoT primarily refers to the connected and smarter world having physical and virtual objects with some unique identities. IoT applications spans across domains of industrial control, retail, energy, agriculture, etc.

This module provides the theoretical and practical aspects of interfacing sensors and actuators, making informed world of Things speaking to each other. The different type of communication modes and models are discussed in detail. The in-depth knowledge of software and packages is provided to make applications in IoT paradigm.

2.4.2.Objective

After completing the module, the incumbent will be able to:

- Understand how connected devices work together to update other applications.
- Acquire knowledge to interface sensors and actuator with microcontroller based Arduino platform.
- Writing C programs in Arduino IDE .
- Understand the Communication between microcontroller and PC using serial communication.
- Build IoT based applications and understand how data flows between things.
- Understand how electronic devices control electrical appliances working at 220v AC.
- Understand security aspect of IoT devices.
- Enhance skill set towards better personality development.

2.4.3.Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.4.4.Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Introduction to IoT – Applications/ Devices, Protocols and	4	6	After completion of this unit of module, Learner will be able to • Understand various IoT Applications, protocols, architecture, etc.

Communication Model			• Understand the characteristics of IoT devices. • Know about Physical Design/ Logical Design, Functional blocks of IoT and Communication Models.
2. Things and Connections	4	6	After completing this unit, Learner will be able to understand • Closed loop/ feedback loop system. • The use of sensors, actuators and controllers in the IoT process flow. • TCP/IP Versus OSI models. • Wired and wireless connectivity.
3. Sensors, Actuators and Microcontrollers	8	12	After completing this unit, Learner will be able to understand • The role of Sensors, transducers in measuring physical quantities. • Working and characteristics of actuators. • Role and use of microcontroller in building various electronic devices.
4. Building IoT Applications	20	30	After completing this unit, Learner will be able to understand • Working of microcontroller and hardware prototyping Arduino platform.

			• The role of 'C' language in building IoT applications. • Built-in Data-type, operators-expressions • Conditional statements and loops. • Arrays, functions. • Digital, analog pins of Arduino. • Interfacing sensors, actuator. • Using Ardublock GUI tool.
5. Security and Future of IoT Ecosystem	4	6	After completing this unit, Learner will be able to understand • Need of security in IoT. • Various basic concept of security. • Security levels. • Need of powerful CPU for Future IoT eco system.
6. Soft skills-Personality Development	8	12	After completing this unit, Learner will be able to understand • Role of positive personality and determinants of personality. • Self-esteem. • Communication and writing skills.

2.4.5.Marks Distribution

Module Unit	Written Marks (Max.)
1. Introduction to IoT – Applications/Devices, Protocols and Communication Model	10
2. Things and Connections	10
3. Sensors, Actuators and Microcontrollers	15

4. Building IoT Applications	40
5. Security and Future of IoT Ecosystem	5
6. Soft skills-Personality Development	20
7. Total	100

2.4.6.Detailed Syllabus

(i) Introduction to Internet of Things – Applications/Devices, Protocols and Communication Model

Introduction - Overview of Internet of Things(IoT), the characteristics of devices and applications in IoT ecosystem, building blocks of IoT, Various technologies making up IoT ecosystem, IoT levels, IoT design methodology, The Physical Design/Logical Design of IoT, Functional blocks of IoT and Communication Models.

(ii) Things and Connections

Working of Controlled Systems, Real-time systems with feedback loop e.g. thermostat in refrigrator, AC, etc. Connectivity models – TCPIP versus OSI model, different type of modes using wired and wireless methodology, The process flow of an IoT application.

(iii) Sensors, Actuators and Microcontrollers

Sensor - Measuring physical quantities in digital world e.g. light sensor, moisture sensor, temperature sensor, etc.

Actuator – moving or controlling system e.g. DC motor, different type of actuators

Controller – Role of microcontroller as gateway to interfacing sensors and actuators, microcontroller vs microprocessor, different type of microcontrollers in embedded ecosystem.

(iv) Building IoT applications

Introduction to Arduino IDE – writing code in sketch, compiling-debugging, uploading the file to Arduino board, role of serial monitor.

Embedded 'C' Language basics - Variables and Identifiers, Built-in Data Types, Arithmetic operators and Expressions, Constants and Literals, assignment.

Conditional Statements and Loops - Decision making using Relational Operators, Logical Connectives - conditions, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement.

Arrays – Declaring and manipulating single dimension arrays
Functions - Standard Library of C functions in Arduino IDE, Prototype of a function: Formal parameter list, Return Type, Function call.

Interfacing sensors – The working of digital versus analog pins in Arduino platform, interfacing LED, Button, Sensors-DHT, LDR, MQ135. Display the data on Liquid Crystal Display(LCD), interfacing keypad

Serial communication – interfacing HC-05(Bluetooth module)
Control/handle 220v AC supply – interfacing relay module.

(v) Security and Future of IoT Ecosystem

Need of security in IoT - Why Security? Privacy for IoT enabled devices- IoT security for consumer devices- Security levels, protecting IoT devices

Future IoT eco system - Need of power full core for building secure algorithms, Examples for new trends - AI, ML penetration to IoT

(vi) Soft skills-Personality Development

Personality Development - Determinants of Personality- self-awareness, motivation, self-discipline, etc., building a positive personality, gestures.

Self-esteem - self-efficacy, self-motivation, time management, stress management, Etiquettes & manners.

Communication and writing skills- objective, attributes and categories of communication, Writing Skills – Resume, Letters, Report, Presentation, etc. Interview skills and body language.

2.4.7. Use-case for building IoT based Applications

A. Using Arduino and sensors/actuators

i. Interfacing Light Emitting Diode(LED)- Blinking LED :
This use case will be used for familiarizing the GPIO peripheral of at mega micro controller. The LED will be used as a device and GPIO will work as output mode.

ii. Interfacing Button and LED – LED blinking/glow when button is pressed
This use case will help to understand the GPIO in two different modes, Input - Button and LED - output mode.

iii. Interfacing Light Dependent Resistor (LDR) and LED, displaying automatic night lamp
This use case will help to understand ADC peripheral and how to read analog data from sensors.

iv. Interfacing Temperature Sensor(LM35) and/or humidity sensor (e.g. DHT11)
This use case will help to connect traditional environmental monitoring sensors (Temperature and humidity) to the Arduino development board. Also use the suitable libraries for implementing these case studies.

v. Interfacing Liquid Crystal Display(LCD) – display data generated by sensor on LCD

This case study will demonstrate how to provide local display unit with Arduino micro controller. Use suitable libraries for implementing these case studies.

vi. Interfacing Air Quality Sensor-pollution (e.g. MQ135) - display data on LCD, switch on LED when data sensed is higher than specified value.
This use case will help to understand how to use traditional smart pollution management sensors with Arduino platform for developing applications as a part of smart city projects.

vii. Interfacing Bluetooth module (e.g. HC05)- receiving data from mobile phone on Arduino and display on LCD
This use case will help to understand the connectivity solution to Arduino to a gadget like mobile phone. Bluetooth is used as connectivity solution in this application.

viii. Interfacing Relay module to demonstrate Bluetooth based home automation application. (using Bluetooth and relay).
This use case will enable the IoT node capability of Arduino development boards by integrating actuator (relay connected to GPIO) to Arduino board and remote connectivity (Using Bluetooth) using a mobile phone with the help of a readily available Bluetooth serial application.

2.4.8.Recommended Books/Study Material

1. Macro Schwartz, "Internet of Things with Arduino- Cookbook", Packt 2016
2. Arshdeep Bajga and Vijay Madisetti, "Internet of Things- A Hands-on Approach" Universities Press, 2014
3. Massimo Banzi, "Getting started with Arduino", 2nd Edition, Oreilly, 2011 [Make:Makezine.com]
4. Macro Schwartz, "Internet of Things with Arduino", Open Home Automation
5. Michael Margolis, "Arduino Cookbook", Oreilly, 2011

2.5. Module: A5-R5- Data Structure Through Object Oriented Programming Language

2.5.1.Introduction

Good knowledge of data structures and algorithms is the foundation of writing good code. Having good knowledge of essential Data structures like array, string, linked list, stack, queue, tree, graph etc makes one understand when to use which Data Structure and accordingly reduce the space and time complexity of the algorithm. Using the right data structure can drastically improve the performance of an algorithm.

In depth understanding of Data Structures, enables one to understand how computer gets things done. Everything from memory allocation in the depths of operating system, to the inner workings of an RDBMS, to how networking stack manages to send data from one place to another, all computers rely on fundamental data structures and algorithms, so understanding them better makes one understand the computer better.

In this course, the Data Structures and algorithms have been implemented using Object Oriented Approach with C++.Object-oriented programming (OOP) is a programming language model in which programs are organized around data, or objects, rather than functions and logic. An object can be defined as a data field that has unique attributes and behavior. OOP approach enables a programmer to deal with real world entities. This opposes the historical approach to programming where emphasis was placed on how the logic was written rather than how to define the data within the logic.

2.5.2.Objective

The course is designed to impart knowledge and develop skills required to solve real world problems using Object Oriented Approach, Python constructs. The focus will also be on fundamentals of Data Structures, Abstract concepts and how these are useful in problem solving.

After completing the module, the student will be able to understand:

- Basics of Object oriented Programming
- Understand the OOP concepts- Abstraction, Objects, Classes, Polymorphism, Inheritance
- Implementation of Object Oriented concepts using C++ classes
- Analyze step by step and develop algorithms to solve real world problems
- Implementation of Data Structures like Linked List, Stack, queue, Trees, Graphs
- Sorting and Searching Techniques with focus on space and time complexity of algorithms

2.5.3.Duration

120 Hours - (Theory: 48hrs + Practical: 72 hrs)

2.5.4.Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical/ Tutorial) in Hours	Learning Objectives
1. Object Oriented Concepts	2	3	After completion of this unit of module, the candidate will be able to • Have an understanding of Basic concepts of Object Oriented approach of programming and how it is different from traditional procedural approach
2. Bsics of C++ and C++ classes nd Objects	10	15	After completing this unit, learner will be able to understand • Basics of C++,Data types, Operators, control structures, arrays, pointers, Functions, Basic input/output and will be able to solve simple problems in C++ • Use of C++ language to create classes and objects • Implementation of all OOPs concepts- Polymorphism, Data Abstraction, Inheritance • Understand the concept of Operator Overloading
3. Analysis of Algorithm	2	3	After completing this unit, learner will be able to

			understand • Analysis of various algorithms in terms of space and time complexity • Concept of Big- O notation.
4. Searchin and Sorting	8	12	After completing this unit, learner will be able to understand • Various Searching techniques and their comparison in terms of time complexity • Various sorting techniques and their comparison in terms of time complexity
5. Elementary Data Types- Arrays, Linked Lists and Types	8	12	After completing this unit, learner will be able to understand • Implementation of 1-D and 2-D arrays and various operations to be performed on arrays • Creation of new structures like- Linked list, double Link List, Circular Link List and all the operations related to same
6. Stacks and Queues	6	9	After completing this unit, learner will be able to understand • Implementation of stacks and queues • Understand the use of the two data structures.

7. Trees	8	12	After completing this unit, learner will be able to understand • Nonlinear Data Structure-trees and different modes of traversals • Implement different types of trees-BST, Threaded Binary Tree, B tree and practical use of the same
8. Graphs	4	6	After completing this unit, learner will be able to understand The concept of Graph and its implementation through Adjacency Matrix and various traversal techniques of graphs

2.5.5. Marks Distribution

Module Unit	Written Marks (Max.)
1. Object Oriented Concepts	5
2. Basics of C++, classes and objects	20
3. Analysis of algorithms	8
4. Sorting and Searching	12
5. Elementary Data Structures- Arrays, Linked Lists	15
6. Stack and Queue	15
7. Trees	15
8. Graphs	10
Total	100

2.5.6.Detailed Syllabus

(i) Object Oriented Concepts

Object Oriented Programming- a new paradigm, Abstraction, forms of Abstraction, OOP concepts- Classes, Objects, Polymorphism, Data Encapsulation, Data Hiding, Inheritance,

(ii)Basics of C++, Classes and Objects

Features of C++, Tokens, keywords, Data types, Operators, Manipulators, Console input , output, Control statements (conditional and loops), Functions, Classes, Instantiation, Destructor, constructor, Polymorphism - Operator Overloading, Function Overloading ,Inheritance-Single , Multiple, Multilevel, Pointers

(iii) Analysis of Algorithm

Introduction to algorithm design and Data structures, Comparison of Algorithms, Complexity in terms of space and time, Calculation of O- notation. Abstract Data type and its implementation with a Rational number example

(iv) Searching and Sorting

Searching- Linear and Binary Search, Sorting- Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Comparison of various searching and sorting techniques in terms of time complexity

(v) Elementary Data Structures: Arrays, Linked Lists

Representation of arrays-single and multidimensional, Address calculation using row major ordering, Various operations on arrays, Linked Lists-Singly Linked List, Double linked List, Circular Linked List- traversing, deleting, inserting, searching, counting, reversing, printing of nodes.

(vi) Stacks and Queues

Stack ADT, Implementation of stack using array and linked list, Application of Stack- Evaluation of postfix/prefix expression, Queue ADT, Implementation of queue using Array and Linked List

(vii) Trees

Definition and notations, Binary Search Trees Implementation. Traversals using stacks and recursion - In-order, post-order, pre-order techniques, Threaded binary tree, B-trees with implementation of 2-3 trees.

(viii) Graphs

Definition and notations, Components of Graphs, Types of Graphs, Graph Implementation using Adjacency Matrix and Adjacency List algorithms and programs, Graph Traversal Methods : Depth First Search and Breadth First Search.

2.5.7.Reference Books/Study Material

1. Object Oriented Programming with C++ by Robert Lafore
2. Object Oriented Programming with C++ by E Balaguruswamy
3. Data Structures through C++ by Yashwant Kanetkar
4. Schaum's Outlines Data Structures Seymour Lipschutz

2.6. Module: A6-R5- Computer Organization and Operating System

2.6.1.Introduction

Operating System is an intermediate software layer between user and computer hardware. The program which is executed on computer requires difference resources like memory, hardware, CPU etc. On the other hand, computer consists of various blocks memory, ALU, control unit, input/output devices and other peripherals. This module provides information on both the topics, Computer Organization and Operating System. The functions of Operating System helps user to interact with all components computers.

2.6.2.Objective

The objectives of this module are:

- To have a thorough understanding of the basic structure and operation of a digital computer.
- To discuss in detail the operation of the arithmetic unit including the algorithms & implementation of fixed-point and floating-point addition, subtraction, multiplication & division.
- To study the communication with I/O devices and standard I/O interfaces.
- To study the hierarchal memory system including cache memories and virtual memory.
- To gain knowledge of functions of operating system like memory management, scheduling, file system and interface, distributed systems, security and deadlocks.
- To understand how an Operating System handles multiple processes.

2.6.3.Duration

120 Hours - (Theory: 70 hrs + Practical: 50 hrs)

2.6.4.Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Basic Structure of Computers	6	9	After completion of this unit of module, the candidate will be able to • Get familiar with various components of a computer and their function. • Get familiar with Von Neumann Architecture.

2. Computer Arithmetic Operations	10	15	After learning this unit, candidate will be: • Well acquainted with logic gates and Boolean algebra. • Get familiar with representation of fixed and floating point numbers in system • Get familiar with binary arithmetic.
3. Central Processing Unit and Instructions	10	15	After completion of this unit, candidate will have in depth knowledge of • General registers • Types of instructions • Addressing modes • PCB.
4. Memory Organization	8	12	After completion of this unit, candidate will have knowledge about • Primary memory • Secondary memory • Cache memory • Virtual memory • RAID
5. I/O Organization	6	9	After completion of this unit, candidate will have basic Knowledge of: • peripheral devices • Data transfer modes • Interrupt handling • DMA
6. Operating Systems Overview	3	3	After completion of this unit, candidate will be able to • Gather knowledge of various types of operating systems • Get an overview of various functions performed by OS

			• Get an overview about kernel and shell • Get an overview of system calls
7. Linux Basics	8	12	After completion of this unit, candidate will be able to • Use Linux operating system • Get familiar with basic Linux shell commands like who, whoami, echo, date • Get familiar with navigating manual pages and getting help for a command. • List contents of a directory • Create and remove files and directories. • Check Inode no of a file • Copy or move files or directories • Work with large text files using commands like more, less, head, tail, cut • Search text within a file using grep command
8. Process Management and Shell Script	10	15	After completion of this unit, candidate will be able to • Get familiar with process and its states • Know about Inode structure • Know the various scheduling techniques • Start a task in background and move it to foreground • Write shell scripts.
9. Users, Groups and Permissions	4	6	After completion of this unit, candidate will be able to • View security permissions of a file • Create a new user or group • Modify existing user • Modify the ownership of a

			file. • Modify the permission of a file • Monitor the logins
10. Standard I/O and Pipes	3	9	After completion of this unit, candidate will be able to • to redirect output to a file • to redirect input from a file • take the output of one command and send it into another command as input
11. Finding and processing files	2	3	After completion of this unit, candidate will be able to • locate files based on various criteria such as filename, size, date, type and permission

2.6.5.Marks Distribution

Module Unit	Written Marks (Max.)
1. Basic Structure of Computers	5
2. Computer Arithmetic Operations	10
3. Central Processing Unit and Instructions	8
4. Memory Organization	8
5. I/O Organization	9
6. Operating Systems Overview	8
7. Linux Basics	16
8. Process Management and Shell Script	13
9. Users, Groups and Permissions	10
10. Standard I/O and Pipes	8
11. Finding and processing files	5
Total	100

2.6.6.Detailed Syllabus

Part 1 – Computer Organization

(i) Basic Structure of Computers

Structure of a Computer System, Arithmetic Logic Unit, Control Unit, Bus Structure, Von Neumann Architecture.

(ii) Computer Arithmetic Operations

Introduction to logic gates, Boolean algebra, Data Representation-Number system, Fixed and Floating point numbers, Floating point representation, Signed numbers, Binary Arithmetic, 1's and 2's Complements Arithmetic, Binary adder, 2's Complement method for multiplication, Map Simplefication.

(iii) Central Processing Unit and Instructions:

General Register Organization, Types of Instructions, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Instruction cycle.

(iv) Memory Organization:

Characteristics of Memory Systems, Type of memories, Main memory, Static & Dynamic memories, Secondary Memory, Performance Considerations, Cache Memory with mapping, Virtual Memory, Address memory used pages, page replacement, Introduction to RAID.

(v) I/O Organization

Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer Modes, Interrupt handling, Types of Interrupts, Priority Interrupt, Direct Memory Access, Input-Output Processor (IOP), Synchronous and Asynchronous Data Transfer.

Part 2 – Operating System

(vi) Operating Systems Overview:

Overview of Computer Operating Systems, Types of OS, Functions of OS, Protection and Security, Distributed Operating Systems, System Calls, Scheduling algorithms, memory management, threads.

(vii) Linux Basics

Open source, Overview of Linux, Basic Linux commands, structure of kernel and shell, Getting help, Linux File System, Some Important Directories, Inodes, Current Working Directory, File and Directory Names, Absolute and Relative Pathnames, Creating and Removing Directories, Changing Directories, Listing Directory Contents, Creating and Removing Files, Copying Files and Directories, Moving and Renaming Files and Directories, fundamental file types, Hard Links, Symbolic (or soft) Links, Viewing and working with large

Text files – cat, more, less, head, tail, cut commands, search text within a file, grep.

(viii) Process Management and Shell Script

Processes: Definition, Process Relationship, Process states, Process State transitions, Process Control Block, Context switching – Threads – Concept of multithreads, Listing Processes, Finding Processes, Foreground and background processes, Interactive Process management tools, Sending signals to processes. Shell Script, shell variables, control structure using variables in shell script.

(ix) Users, Groups and Permissions

Users, Groups, Linux File Security, Examining Permissions, accessing root user, creating user and groups, Changing File Ownership, Changing Permissions – Symbolic Method, Numeric Method, /etc/passwd, /etc/shadow and /etc/group files, Monitoring Logins, Default Permissions, Special Permissions umask, passwd.

(x) Standard I/O and Pipes

Standard Input and Output, Redirecting Output to a File, Redirecting STDOUT to a Program(Piping), Combining Output and Errors, Redirecting to Multiple Targets (tee), Redirecting STDIN from a file.

(xi) Finding and Processing Files

Locate, find, Basic find Examples, find and Logical Operators, find and Permissions, find and Access Times.

2.6.7.Reference Books/Study Material

1. Operating System Concepts by Peter B. Galvin, Greg Gagne and Abraham Silberschatz
2. Computer System Architecture by Morris Mano

2.7. Module: A7-R5- Databases Technologies

2.7.1.Introduction

Application software requires data to be stored permanently. Databases provide the facility to store data permanently. Further, databases provide functionality to maintain and retrieve data. Depending upon different types of data storage, retrieval and processing, different types of databases are required. This module is designed with view to equip learner with two types of databases, RDBMS and NoSQL databases.

2.7.2.Objective

The module is designed to equip a learner to acquire knowledge of the current trend and technologies of Databases. It provides theoretical background as well as in depth knowledge of Software/ packages. After completing the module, the incumbent will be able to:

- Understand Database design using Normalization and E-R modelling
- Use Standard Query Language and its various versions.
- Understand importance of backup and recovery techniques.
- Develop Database System to handle real world problem.
- Understand to use Maria DB
- Learn concept of JSON Object & NoSQL Database

2.7.3.Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.7.4.Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. An overview of DBMS	2	3	After completion of this unit of module, the candidate will be able to • Identify different types of Databases • Difference between file based system and database system
2. An Architecture of the Database System	4	6	After learning this unit, candidate will be: • Able to understand three tier architecture. • Able to understand the role

			of DBA • gaining knowledge of E-R Model.
3. Relational Database Management System(RDBMS)	4	6	After completion of this unit, candidate will have in depth knowledge of • RDBMS terminology • Relational Model, Base tables and keys
4. Database design	8	12	After completion of this unit, candidate will be able to • Understand normal forms • E-R Diagram
5. Maria DB	8	12	After completion of this unit, candidate will have good knowledge on • Maria DB
6. Manipulating Data with MariaDB	10	15	After completion of this unit, candidate will be able to • Manipulate data using MariaDB database • Apply various SQL statements.
7. NoSQL Database Technologies	10	15	After completion of this unit, candidate will be able to • Know the difference between centralized and distributed database and NoSQL Database • Understand the advantages of distributed DB NoSQL Databases. • Get familiar with distributed data storage, transaction and query processing techniques. • JSON Object, Create & Access JSON Object • Know different features of NoSQL • Understand NoSQL Database types • Get familiar with the benefits of NoSQL. • Differentiate between NoSQL and SQL.

			• Know different features of MongoDB
8. Selecting the Right Database	2	3	After completion of this unit, candidate will be able to • Select right database for different types of applications

2.7.5.Marks Distribution

Module Unit	Written Marks (Max.)
1. An Overview of the Database Management System	4
2. Architecture of Database System	6
3. Relational Database Management System(RDBMS)	6
4. Database Design	14
5. Maria DB	20
6. Manipulating Data with MariaDB	20
7. NoSQL Database Technologies	20
8. Selecting Right Database	10
Total	**100**

2.7.6.Detailed Syllabus

(i) An Overview of the Database Management System

What is database? Why database? Database system, database management system (DBMS), advantages of DBMS.

(ii) An Architecture of the Database system

Three levels of architecture, Logical View, Physical View, Conceptual View, Logical data independence, Physical Data Independence

(iii) Relational Database Management System (RDBMS)

Introduction, RDBMS terminology, relational model, base tables, keys, primary key, foreign key, constraints, Codd Rules

(iv) Database Design

Normalization, Normal forms-1NF, 2NF, 3NF, BCNF 4NF and 5NF, E-R Diagram. Mapping ER-diagram to database tables.

(v) Maria DB

Introduction to Maria DB, Data Types, SQL Commands, Create, insert, update, delete, drop, alter, SQL functions (String functions, date functions), indexing, key, primary key, foreign key

(vi) Manipulating Data with Maria DB

SQL Statements, Select, like clause, group by, order by, joins-left join, natural join, right join, union. Correlated and nested queries. Backup and restore commands

(vii) NoSQL Database Technology

Introduction to NoSQL Databases, Difference between relational and noSQL databases. NoSQL features, types, advantages, Architecture of MongoDB, Documents, Collections, Dynamic Schemas, Mongo Shell, Mongo Server and Client, Data Types, Embedded Documents, Creating Configuration file for Mongo,

JSON File format for storing documents, Inserting and Saving Documents, Batch Insert, Insert Validation, Removing Documents, Updating Documents, Document Replacement, Using Modifiers, Updating Multiple Documents, Returning Updated Documents,

Introduction to Indexing, Introduction to Compound Indexes, Using Compound Indexes, Indexing Objects and Arrays, Aggregation Framework, Pipeline Operations- $match, $project, $group, $unwind, $sort, $limit, $skip, Using Pipelines, MongoDB and MapReduce, Aggregation Commands, Introduction to Replication, configuring a Replica Set, Member Configuration Options

(viii) Selecting the Right Database

Selection of right databases, RDBMS or NoSQL, selection of database based on performance, data size, type of data, frequency of accessing data, business needs, type of application.

2.7.7.Reference Books/Study Material

1. Henry F Korth, Abraham Silberschatz and S. Sudharshan, "Database System Concepts", Sixth Edition, McGraw Hill, 2011.
2. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Pearson Education
3. Emilien Kenler and Federico Razzoli, "MariaDB Essentials", Packt Publishing, 2015
4. Kristina Chodorow, "MongoDB: The Definitive Guide", 2nd Edition, O'REILLY
5. Saeed K. Rahimi and Frank S. Haug, "Distributed Database Management Systems-A Practical Approach", WILEY Publication

6. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Fifth Edition, Pearson Education/Addison Wesley.
7. Alex Giamas, "Mastering MongoDB", Packt Publisher.

2.8. Module: A8-R5- Systems Analysis, Design and Testing

2.8.1.Introduction

The module is designed to equip a person to understand System Analysis and Design aspects. It provides theoretical background as well as in depth knowledge through case studies. This module covers both structured and Object oriented techniques to analyse and design software.

2.8.2.Objective

After completing the module, the incumbent will be able to:

- Under the need of system analysis and design in software development
- understand complete life cycle of System analysis and Design
- do the feasibility analysis and design of the proposed system
- use various analysis and design tools and techniques
- get familiar with Object oriented System Design
- understand the role of testing in software development

2.8.3. Duration

120 Hours - (Theory: 48 hrs + Tutorial/Tutorial/Case Studies: 72hrs)

2.8.4.Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Tutorial) in Hours	Learning Objectives
1. Introduction	6	12	After completion of this unit of module, the candidate will be able to • Understand the concepts of system, their types • Understand the different stages of software development life cycle.
2. Requirement Gathering and Feasibility Analysis	8	12	After learning this unit, candidate will be able to understand: • System Requirement Specification and its design • Requirements of system and role of its documentation • Alternate solutions effectively • Conduction of feasibility

			analysis of the proposed system.
3. Structured Analysis	8	12	After completion of this unit, candidate will have in depth knowledge of • Tools used during in analysis of system • Role System Requirement Specification and its design • Understanding requirements of system and its documentation • Will be able to examine alternate solutions effectively • Will be able to do the feasibility analysis of the proposed system Requirement Specification and its design • Understanding requirements of system and its documentation • Will be able to examine alternate solutions effectively • Will be able to do the feasibility analysis of the proposed system of tools in documentation. • Technical Documentation of analysis.
4. Structured Designs	8	12	After completion of this unit, candidate will have good knowledge of • Tools used during software design • Writing technical design document.
5. Object Oriented Modelling Using UML	8	12	After completion of this unit, candidate will be able to • Design object oriented software • Use UML tools during documentation of object

			oriented software.
6. Testing	4	6	After completion of this unit, candidate will be able to • Know the testing techniques available to test the developed software
7. System Implementation and Maintenance	2	3	After completion of this unit, candidate will be able to • Know the processes involved in deploying the software • Know the activities related to maintenance of the software once it is made operational.
8. Other Software Development Approaches	2	3	After completion of this unit, candidate will be able to • Different software development approaches

2.8.5. Marks Distribution

Module Unit	Written Marks (Max.)
1. Introduction	10
2. Requirement Gathering and Feasibility Analysis	10
3. Structured Analysis	20
4. Structured Design	20
5. Object-Oriented Modeling Using UML	20
6. Testing, System Implementation and Maintenance, Other Software Development Approaches	20
7. Total	100

2.8.6. Detailed Syllabus

(i) Introduction

System Definition and concepts, types of systems, systems user, designers, analysts, introduction to simple system development process- initiation, analysis, design, coding, testing, implementation and maintenance. Basic principles of successful systems, Role and Need of Systems Analyst. Qualifications and responsibilities, System Analysis as a Profession.

(ii) Requirement Gathering and Feasibility Analysis

System requirements specification, Classification of requirements as strategic, tactical, operational and statutory, Requirement gathering techniques- interview, questionnaire, on-site observation, document observation, selecting appropriate technique, Feasibility analysis, deciding project goals, examining alternative solutions, Cost Benefit Analysis, quantifications of costs and benefits, payback period, system proposal preparation for managements, parts and documentation of a proposal

(iii) Structured Analysis

Data flow diagrams, case study for use of DFD, good conventions, Leveling of DFDs, Leveling rules, Logical and physical DFDs, Software tools to create DFDs. Preparation of Software Requirement Specification

(iv) Structured Design

Entity relationship model, E-R diagrams, Relationships cardinality and participation, Normalizing relations, various normal forms and their need, Some examples of relational data base design. Data input methods, Designing outputs, output devices, designing output reports, screen design, graphical user interfaces, interactive I/O on terminals.

Application Architecture, server based architecture, client based architecture, n-tier architecture,

Program design- structured chart. Preparation of Design Specification Document,

(v) Object Oriented Modeling using UML

Object Oriented (OO) Development Life Cycle and Modeling. Static and dynamic modeling. Comparison of OO and Module-oriented Approach. Modeling using UML; class diagram, use case diagram, class diagram, object diagram, package diagram, activity diagram, interaction diagrams, sequence diagram, state transition diagram. Deployment diagram.

(vi) Testing

Software Testing, need for software testing, types of testing, Functional Testing-unit testing, integration testing, user acceptance. Non-functional Testing-performance, stress testing, peak load testing, Maintenance Testing-Regression Testing.

(vii) System Implementation and Maintenance

Planning considerations, Conversion methods, procedures and controls, System acceptance criteria, System Evaluation and Performance, Testing and Validation. Preparing, User Manual, Maintenance Activities and Issues.

(viii) Other Software Development Approaches

Different Software Development approaches-waterfall model, prototype, rapid application development, spiral, agile development, DevOps development methodology.

Distributed System, centralized versus distributed system, components of distributed system-processes, interfaces and data. Layers of distributed system-presentation layers, application logic layer, data manipulation layer and data layer. Design and layers of Internet Based applications.

2.8.7.Reference Books/Study Material

1. Henry F Korth, Abraham Silberschatz and S. Sudharshan, "Database System Concepts", Sixth Edition, McGraw Hill, 2011.
2. System Analysis and Design Methods by Jeffrey L Whitten and Lonnie D Bentley, Mc-GRaw Hill
3. System Analysis and Design by Alan Dennis, Barbara Haley Wixom, Roboerta M Roth, Publisher-Wiley
4. Modern Systems Analysis and Design-6th Edition by Hoffer, George, valacich; Published by Pearson Education India
5. System Analysis and Design by Dr. Brijendra Singh, Published by New Age International Private Limited
6. Software Engineering by K. K. Aggarwal and Yogesh Singh, New Age International Publisher

2.9. Module: A9.1-R5- Big Data Analytics Using Hadoop

2.9.1. Introduction

The purpose of this module is to provide skills to students to analyze and process large volume of data using tools and techniques. It provides theoretical background as well as in depth knowledge of Software/ packages that are used in analyzing the voluminous data. After completing the module, the student will be able to:

- Collect and combine data recovered from different sources and in different format into uniform format that will help in analyzing data.
- Understand the basics of data, database, requirement to analyze data, analyzing data using mathematical and statistical techniques, representation of data in tabular and graphical modes.
- The concept and usefulness of cluster environment for processing voluminous data.
- Analyze data using Hadoop framework and its sub-project of HIVE

2.9.2. Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.9.3. Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Analyze and Define Business Requirement	4	6	After completion of this unit of module, the learner will be able to • Differentiate between traditional tools and modern tools to analyze data. • Analyze business requirement through database
2. Introduction to Operating System (Ubuntu/Linux)	4	6	After completion of this unit of module, the learner will be able to • Understand Operating System and its functions. • Manage files and folders. • Know various types of file extensions and their purposes

			• Learn basic commands used in Operating System.
3. Java Programming	10	15	After completion of this unit of module, the learner will be able to • Write programs using Java Programming Language and its main constructs. • Handle exception situations. • Write graphical programs using Java. • Integrate Java with any database. • Integrate any external Java API in application
4. Hadoop Framework and Map Reduce Programming Technique	8	12	After completion of this unit of module, the learner will be able to • Use Hadoop framework for managing voluminous data. • Write programming using MAP Reduce techniques.
5. Anaylzing Data using HIVE	10	15	After completion of this unit of module, the learner will be able to • Process and analyze large volume of data using HIVE
6. Basics of R Programming and RHIVE	4	6	After completion of this unit of module, the learner will be able to • Understand the need of R in analyzing voluminous data. • Integrate R with HIVE
7. HIVE-Java Connectivity	6	9	After completion of this unit of module, the learner will be able to • Connect HIVE with JAVA • Develop GUI using JAVA, HIVE and R
8. Introduction to HBASE, PIG and JAQL	2	3	After completion of this unit of module, the learner will be able to • Understand the purposes of

			other Big Data tools like JAQL, HBASE and PIG.

2.9.4. Marks Distribution

Module Unit	Written Marks (Max.)
1. Analyzing and Defining Business Requirement and Introduction to Operating System (Ubuntu)	10
2. Java Programming	30
3. Hadoop Framework and Map Reduce Programming Techniques	10
4. Analysing Data using HIVE, R, RHIVE, HIVE – JDBC	40
5. Introduction to HBASE, PIG and JAQL	10
6. Total	100

2.9.5. Detailed Syllabus

(i) Analyze and Define Business Requirement

Introduction to Business Intelligence, Business Analytics, Data, Information, how information hierarchy can be improved/introduced, understanding Business Analytics, Introduction to OLAP, OLTP, data mining and data warehouse. Difference between OLAP and OLTP.

Introduction to database, characteristics of data in database, DBMS, advantages of DBMS, file-oriented approach versus Database-oriented approach to Data Management, disadvantages of file- oriented approach. A brief overview of relational model. Definition of relation, properties of relational model, Concept of keys: candidate key, primary key, alternate key, foreign key, Fundamental integrity rules: entity integrity, referential integrity. SQL statements: Insert, delete, update and select. Join, union.

(ii) Introduction to Operating System

Introduction to Ubuntu Operating System, Managing files and folder through command line and Desktop. Basic Ubuntu commands like ls, mkdir, clear, rm. Creating users and groups in Ubuntu. User priviledges and roles (chown and chmod commands), gedit editor. Secure shell configuration, configuring .bashrc and environment files.

(iii) Java Programming

OOPS Principles, an Overview of Java Object-Oriented Programming, Data Types, Variables, and Arrays, Operators-Arithmetic Operators, The Bitwise Operators ,Relational Operators, Boolean ,Logical Operators, Programming Constructs, Methods and Inheritance, The basic Java I/O Classes and String Handling

Exception-Handling Fundamentals, Exception Types ,Uncaught Exceptions , Using try and catch , Displaying a Description of an Exception ,Multiple catch Clauses , Nested try Statements , Throw throws finally Java's Built-in Exceptions Packages, Access Protection, Importing Packages and Interfaces

Java Swing and its controls like JTextField, JLabel, JComboBox, JTable, JButton, JScrollBar, JOptionPane and JMenu.

Java Database Connectivity JDBC-ODBC Bridge JDBC Drivers Creating DSN DriverManager, Connection, Statement, ResultSet. Connecting Java with Database.

(iv) Hadoop Framework and Map-Reduce Programming Technique

Big Data Concepts, Need for analyzing Big Data, its roles in Business Intelligence and decision making.

Big Data, Hadoop Architecture, Hadoop ecosystem components, storage, Hadoop Distributed File System (HDFS), Single node installation. Multi node installations. Cluster Architecture, Cluster configuration files Hadoop commands, Hadoop Server Role, name Node, secondary node, data node, file write and read.

Shell commands, Accessing files on HDFS and local machine, Map Reduce Framework, Developing Map Reduce Programs, structure of Map Reduce program,

(v) Analysing Data Using HIVE

Introduction to HIVE, installing HIVE, Data types, HIVE shell, HIVE commands, HIVE SQL, creating database and tables, bulk loading of data, SQL DML statements, SQL Join, HIVE Functions, Complex Data types, UDF in Hive using Java

(vi) Basics of R Programming and RHIVE

R Overview, Basic Syntax, Data types, R Control constructs like loop and conditional, R Function. Connecting R with Hive.

(vii) HIVE JDBC Connectivity

Starting HIVE in client-server mode, beeline, mapping HIVE datatype with Java datatypes, Connecting Java with HIVE. Integrating Java Swing, HIVE and JDBC for developing front end application.

(viii) Introduction to HBASE, PIG and JAQL

HBASE introduction, integration with Hadoop, HBase Shell, introduction to JAQL data model, JAQL shell, introduction to JSON files and accessing JSON files through JAQL. Introduction to PIG.

2.9.6.Reference Books/Study Material

1. Java - The Complete Reference by H. Schildt, Tata McGraw-Hill.
2. Head First Java by Kathy Sierra & Bert Bates, O'Reilly.
3. Programming with Java A Primer by E Balagurusamy, Tata McGraw-Hill.
4. Hadoop, The Definite Guide by Tom White, O'REILLY
5. Hadoop Operation by Eric Sammer, O'REILLY
6. Big Data by DT Editorial Services, Black Book
7. Apache HIVE Essential, Dayong Du, Packt Publisher
8. HBASE Essentials by Nishant Garg, Packt Publisher

2.10. Module: A10.1-R5- Data Science Using Python

2.10.1. Introduction

Data science is an interdisciplinary field that uses scientific processes and various algorithms to extract knowledge and insights from data which may be structured and unstructured.

Python has gathered a lot of interest recently as a choice of language for data analysis/science. Python is a free and open source and a general-purpose programming language which is easy to learn. Python, due to its versatility, is ideal for implementing the steps involved in data science processes. Python is being used for web development, data analysis, artificial intelligence, and scientific computing.

The three best and most important Python libraries for data science are NumPy, Pandas, and Matplotlib. NumPy and Pandas are used for analyzing and exploring with data. Matplotlib is a data visualization library used for making various types of graphs depicting the analysis.

2.10.2. Objective

With the growth in the IT industry, there is a booming demand for skilled Data Scientists and Python has evolved as the most preferred programming language for the same. This course will focus on fundamental python programming techniques, reading and manipulating csv files, and the various libraries for data science.

After completing the module, the student will be able to:

- take tabular data and clean it
- manipulate the data
- run basic inferential statistical analyses.
- Perform Data Analysis
- Perform Visualization of analysis
- Built a Front end GUI

2.10.3. Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.10.4. Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Python Language, Structures, Programming Constructs	6	10	After completion of this unit of module, the candidate will be able to • Write programs in the Python language. • Extensively use conditional statements, loops and various data structures of python.
2. Data Science Concepts	2	0	Learner will understand the concept of Data Science and Analytics and various steps to achieve analysis.
3. Numpy	8	16	After completing this unit, learner will be able to understand • Scientific computing and data analysis by understanding large, multi-dimensional arrays and matrices • Run efficient operations on arrays • work on high-level mathematical functions to operate on these arrays.
4. Pandas	14	20	After completing this unit, learner will be able to understand • Data Analysis after importingdata from various sources. • Understand the Series and DataFrame as the central data structures for data analysis. • Learn various functions,

			grouping, merging and querying large sets of data.
5. Statistical Concepts and Functions	6	9	After completing this unit, learner will be able to understand • The statistical tool of python having ability to manipulate some statistical data and calculate results of various statistical operations. • Understand functions like mean, median, mode and standard deviation. • Understand the concept of Correlation and Regression.
6. Matplotlib	6	9	After completing this unit, learner will be able to understand • Learn the python library used to create graphs and plots with just a few commands • Understand pyplot and its features of line styles, font properties, formatting axes etc. • Understand all aspects of the programmatical control of all the figures..
7. GUI - Tkinter	4	8	After completing this unit, learner will be able to understand • The standard python interface to the Tk GUI toolkit for creating quick and intuitive GUI. • The various widgets for

			input and their event handling. • Integrating the data analysis and graphs in Tkinter.
8. Machine Learning	2	0	This will help the learner have an overview of Machine Learning and its concepts.

2.10.5. Marks Distribution

Module Unit	Written Marks (Max.)
1. Python Language, Structures, Programming Constructs	14
2. Data Science Concepts	6
3. Numpy	20
4. Pandas	24
5. Statistical Concepts and Functions	10
6. Matplotlib	10
7. GUI –Tkinter	12
8. Machine Learning – The Next Step	4
Total	100

2.10.6. Detailed Syllabus

(i) Python Language, Structures, Programming Constructs

Review of Python Language, Data types, variables, assignments, immutable variables, Strings, String Methods, Functions and Printing, Lists and its operations, Tuples and Dictionaries programs, Slicing strings,lists, tuples.

(ii) Data Science and Analytics Concepts

What is Data Science and Analytics? The Data Science Process, Framing the problem, Collecting, Processing, Cleaning and Munging Data, Exploratory Data Analysis, Visualizing results.

(iii) Introduction to NumPy Library

Numpy : Array Processing Package, Array types, Array slicing, Computation on NumPy Arrays – Universal functions ,Aggregations: Min, Max, etc., N-Dimensional

arrays, Broadcasting, Fancy indexing, sorting arrays, loading data in Numpy from various formats.

(iv) Data Analysis Tool : Pandas

Introduction to the Data Analysis Library Pandas, Pandas objects – Series and Dataframes, Data indexing and selection, Nan objects, Manipulating Data Frames, Grouping, filtering, Slicing, Sorting, Ufunc, Combining Datasets- Merge and join. Query DataFrame structures for cleaning and processing, lambdas. Aggregation functions and applying user defined functions for manipulations.

(iv) Statistical Concepts and Functions

Statistics module, manipulating statistical data, calculating results of statistical operations. Python Probability Distribution, Functions like mean, median, mode and standard deviation. Concept of Correlation and Regression.

(v) Matplotlib

Visualization with Matplotlib, Simple line plots, scatter plots, Density and Contour plots – visualizing functions, Multiple subplots, Plotting histograms, bar charts, scatter graphs and line graphs.

(vi) GUI – Tkinter

Tk as Inbuilt Python module, creating GUI applications in Python. Creating various widgets like button, canvas, label, entry, frame, checkbutton, label etc. Geometry Management: pack, grid, place, organizing layouts and widgets, binding functions, mouse clicking events. Building the complete interface of a project.

(vii) Machine Learning : The Next Step

What is Machine Learning ? Types of Machine Learning Algorithms, Training the data and Introduction to Various Learning Algorithms. Applications of Machine Learning.

2.10.7. Reference Books/Study Material

1. Python for Data Analysis by OReilly
2. Getting started with Python Data Analysis
3. Python Data Science Handbook: Essential Tools for Working with DataByOReilly
4. Python for Data Science for Dummies

2.11. Module: A9.2-R5- Web Application Development Using PHP

2.11.1. Introduction

The combination of PHP and MySQL is the most convenient approach to dynamic, database-driven web design. Flexible, scalable, extensible, stable, open—PHP is all of these and more, which is why it's one of the most popular programming toolkits in the world. Today, more than 20 million domains use PHP, including Facebook and Yahoo.PHP is easily embedded with HTML, and is used to manage dynamic content and the databases of websites or, we can say, Web applications. We can use PHP with many popular databases like MySQL, PostgreSQL, Oracle, Sybase, Informix and Microsoft SQL Server.

So using PHP is also good economics for organizations: it allows them to save on licensing fees and expensive server hardware, while simultaneously producing higher-quality products in shorter time frames. Any would-be developer on a Unix/Linux or even a Windows/Apache platform will need to master these technologies. At the same time, JavaScript is important, as it provides in-browser dynamic functionality and, through Ajax, hidden communication with the web server to create seamless interfaces. In conjunction with CSS, these technologies integrate to provide a formidable array of powerful web-development tools.

2.11.2. Objective

The module is designed to equip a person with skills of web application development using PHP & MySQL under Linux environment. The module will cover aspects of how to use PHP, MySQL and client-side validations like AJAX and JQUERY to create powerful and easy to maintain database driven web-based applications. It provides depth knowledge of web application development using open source tools like Linux, Apache, MySQL and Php. After completing the module, the incumbent will be able to:

- Work on Linux operating System.
- Designing of Web Pages
- Configure and implement security features on Apache.
- Design a Database in MySQL
- Perform MySQL Administration
- Work in programming language PHP
- Develop a Website using Open Source Technologies

2.11.3. Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.11.4. Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Introduction to the Website Development	02	3	After completion of this unit of module, the candidate will be able to understand • the concept of Webpages and Website • Open Source Technologies • Platforms for PHP Website Development • Server-Side Scripting language and Client-Side Scripting language
2. Introduction to Linux Operating System	04	06	After completion of this unit of module, the candidate will be able to • Execute basic Linux Commands. • Configure IDE for web development. • Install and configure web server. • Configure php and MySQL in Linux environment.
3. Review of Designing Web pages	04	06	After completion of this unit of module, the candidate will be able to • Design a web page • Create and implement CSS
4. Review of Client Side Validations using various techniques	04	06	After completion of this unit, candidate will have in depth knowledge of • Applying Client-side validations using Java Script and AJAX • Applying Client-side validations using JQuery
5. Implementation of a server side programming language PHP	16	24	After completion of this unit, candidate will have good hands-on practice on • Acquiring skills on programming concepts • Acquiring skills on architecture of front-end application • Acquiring skills on

			implementation of basic concepts in php programming. • Acquiring skills on implementation of object-oriented concepts in Php. • Acquiring skills to understand the paradigm for dealing with form-based data • Acquiring Skills on file handling • Attaining skills on integrating application with back end database • Attaining skills on server-side validations • Attaining skills on implementation of security features.
7. Database connectivity with PHP and MySQL	16	24	After completion of this unit, candidate will have good hands-on practice on • Database Connectivity • Can handle Data manipulations • CRUD (Create, Read, Update and Delete)Operations in MySQL-Php • User Authentication and authorization • Website development
8. Web Services & security vulnerabilities	04	06	After completion of this unit, candidate will have good hands-on practice on • Implementation Web Services. • Web Security and Security Vulnerabilities.

2.11.5. Marks Distribution

Module Unit	Written Marks (Max.) (100)
1. Introduction to the Website Development	02
2. Introduction to Linux Operating System	02
3. Review of designing of Web pages	10

4. Review of Client Side Validations using various techniques	10
5. Server side programming language PHP	30
6. Database connectivity with PHP and MySQL	36
7. Web Services & security vulnerabilities	10

2.11.6. Detailed Syllabus

(i) Introduction to the Website Development

Introduction of Web Site: Concept of Website and WebPages, types of Websites
Introduction to Open source Technologies: Operating system, Web Server, Database, Scripting Languages
Platforms for website development: LAMP,WAMP and MAMP, Scripting language

(ii) Introduction to Linux Operating System

Linux Operating System,: Topics- Introduction, Installation, Linux Architecture, Boot Process, Kernel, System Initialization. Different flavours of Linux, Review of Basic Commands and Editors: Topics – Introduction to NetBeans, Installation and Configuring NetBeans,gedit, Notepad++, Configuring Servers: Installation of Php and MySQL on Linux Operating System, Installation of Net Beans IDE and its configuration, Configuration of Apache Server

(iii) Design of Web Pages

Basic HTML:HTML Basics, HTML Elements, HTML Attributes, HTML Headings, HTML Paragraphs, HTML Styles, HTML Formatting, HTML Quotations, HTML Links, HTML Table, HTNL Lists, HTML Blocks, HTML Classes, HTML IFrames etc.

HTML Forms: HTML Form Elements, Input Types, Input Attributes.

CSS: CSS Introduction, CSS Types, CSS Padding, CSS Id & Class, Styling Backgrounds Fonts, Links, CSS Border, HTML5

(iv) Client Side Validations using various techniques

Java Script: Java Script Introduction, Variable declaration, Operators, Control Statements, Error Handling,understanding arrays,Built in Functions, User defined Function, HTML Forms and Java Script, HTML DOM,Validations using Java Script

AJAX: Introduction to AJAX, XMLHttp Request Object, Response Handling, AJAX Components, AJAX Framework, HTML in AJAX, XML and AJAX, Validations using AJAX

JQUERY: JQUERY Introduction, JQUERY library, JQuery Selectors, JQuery Filters, Working with JQuery Events, JQuery and HTML Forms, Validations using JQuery

(v) Server side programming language PHP

Introduction of Php: Programming Concepts, Architecture of web application, Php Data Types and basics
Control Structures: Conditional statement, if, else, case, for, while loops

Arrays in Php: Types of Arrays, Array attributes, Associative arrays, Array functions.

PHP Functions: String and other functions in PHP, Super global, PHP Functions,Types of Function:User Defined Function and Inbuilt Functions, PHP Email Function etc.
Object Oriented Concepts: Classes, Defining a class and its usage, Constructor, Inheritance, Exception Handling, Use of include and require.

PHP Forms methods: GET,POST & REQUEST, creating user forms.

File handling in PHP: Uploading files and images, Using file system in php.

(vi) Database connectivity with PHP and MySQL

Creation of Database Connection file, Database connectivity, using MySQL functions in php. Server-side validations. Inserting, Updating,deleting data using PHP and MySQL through forms, Bind Parameters for Database Queries, Using MySQL Store procedures in PHP, Database server configuration using IPv4 and IPv6, Fetching Data from Database server.

(vii) Web Services & security vulnerabilities

Web service architecture & Introduction, Session and cookies, Authentication and Authorization, storing hashed passwords in the database, Login and Logout operation, Access Control Filter, Session based and cookie-based login, Using security features etc. SQL Injection, Cross Site Scripting, Broken Authentication and Session Management, Insecure Direct Object References, Cross Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to restrict URL Access.

2.11.7. Reference Books/Study Material

1. PHP and MySQL® Web Development: Publisher: Addison-Wesley Professional Author: Laura Thomson, Luke Welling
2. Beginning PHP6, Apache, MySQL Web Development Publisher: Wrox Author: Elizabeth Naramore, Jason Gerner, Yann Le Scouarnec, Jeremy Stolz, Michael K.Glass Timothy Boronczyk

2.12. Module: A10.2-R5- Full Stack Web Development using MVC Framework

2.12.1. Introduction

The Model-View-Control (MVC) pattern, is a software architecture pattern built on the basis of keeping the presentation of data separate from the methods that interact with the data. In theory, a well-developed MVC system should allow a front-end developer and a back-end developer to work on the same system without interfering, sharing, or editing files either party is working on.

PHP MVC is an application design pattern that separates the application data and business logic (model) from the presentation (view). MVC stands for Model, View &Controller. The controller mediates between the models and views.

Frameworks can help to overcome the long lines of code of PHP that have multiple unwanted interactions and typically they HTML code within them. More than anything, they provide a platform for creating clean and organized code. When your code is organized, it is easy to test each individual piece of code against test cases. Changing a small php function will update functionality throughout application. In most of frameworks, many pre-built and pre-tested tools included. Ultimately, frameworks lead to better organization of code, which in most cases can make or application development experience less painful.

2.12.2. Objective

The module is designed to equip a person to use PHP & MySQL with MVC framework. The module will cover aspects of how to use PHP, MySQL along with CakePHP MVC framework to create powerful and easy to maintain database driven websites.PHP, MySQL and CakePHP are also platform independent i.e. You can easily port a website developed on a windows machine to a Linux based apache web server with minimal to no changes.

After completing the module, the incumbent will be able to:

- Understand the basics of the Web Technology
- Learn all major concepts of PHP and MySQL that beginner developers need to master.
- Learn all major concepts of MVC architecture in general and it advantages over conventional web development methods.
- Round off your application development skills by understanding how to implement PHP on a website using MVC framework.
- Gain the PHP programming skills needed to successfully build interactive, data-driven sites
- Create forms easily using helper functions and work with form data
- Object oriented concepts
- Able to architect, write, debug, and run complete web applications
- Test and debug a PHP application

2.12.3. Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.12.4. Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. PHP Basics and Conditional Logic	4	6	After completion of this unit of module, the candidate will be able to understand • PHP and MYSQL Basics • Installation Setup,Data Types. • Get familiar with Arrays and Decision Making Statement.
2. Functions and Error Handling	3	6	After learning this unit, candidate will be: • Well acquainted with functions and its uses. • Able to understand various types of Functions . • Able to create user defined functions. • Well versed with Regular Expressions.

3. Object Oriented Programming	8	12	After completion of this unit, candidate will have in depth knowledge of
			• Object Oriented Concepts
			• Classes, creation of Objects for Class.
			• Methods and functions
			• Object oriented functionalities i.e.
			  • Inheritance
			  • Method Overriding
			  • Interfaces
			  • Constants
			• Access Specifiers and Abstract Classes.

4.MySQL Installation and Basics	3	6	After completion of this unit, candidate will acquire knowledge on : • Database and Database Terminology

			• Database creation and Connection • Database manipulations like add, edit and delete
5. Advance Queries and Data Manipulation using PHP and MySQL	6	10	After completion of this unit, candidate will gain knowledge and hands-on practice on • Advanced Queries. • SQL Injection • Sorting and Indexing • Joins • Retrieving and manipulating Data using PHP. • Creation of Login and Registration form for user authentication • Searching,Updation,Deletion of data and users
6. MVC Infrastructure Basics, Frameworks& Introduction to CakePHP	4	8	After completion of this unit, candidate will be able to • Gather knowledge MVC Terminology • Advantages of MVC • Brief Information about MVC Frameworks of PHP • Installation of CakePHP • Configurations required for Framework
7. Models	6	6	After completion of this unit, candidate will learn • Models in detail • Defining Models • Use it for database access and manipulation How to use basic SQL queries in models
8. Controller & Views	6	8	After completion of this unit, candidate will be able to • Create Controllers • Create Views • Controllers and Views Interaction and exchange data between them

9. Creating Dynamic Forms using CakePHP Html Helpers	8	10	After completion of this unit, candidate will be familiar with the • Generate forms using CakePHP • Validate forms using model definitions. • Difference between get and post methods • Sessions and cookies • File uploading

2.12.5. Marks Distribution

Module Unit	Written Marks (Max.)
1. PHP Basics and Conditional Logic	10
2. Functions and Error Handling	10
3. Object Oriented Programming	13
4. MySQL Installation and Basics	7
5. Advance Queries and Data Manipulation using PHPand MySQL	13
6. MVC Infrastructure Basics , PHP Frameworks& Introduction to CakePHP	14
7. Models	11
8. Controller, Views	12
9. Creating Dynamic Forms using CakePHP Html Helpers	10
Total	100

2.12.6. Detailed Syllabus

(i) Php Basics and Conditional Logic

PHP introduction, Environment setup in different platforms, concept of Server side scripting language and client side scripting language, Script syntax, How to declare variable and data types, Constants, Arrays, Strings, Web concepts, Decision making statements, loop types, operators

(ii) Functionsand Error handling

What is Functions , Creating PHP functions, PHP functions with parameters, Argument by reference, setting default values for function parameters, dynamic

function calls, regular expressions, Date and time functions ,Built-in functions, file inclusion, file manipulations

(iii) Object Oriented Programming

What is Object Oriented Concepts, Defining classes, Creating Objects, Member functions, The new keyword and Constructor ,Destructor, Access method and properties using $this variable, Inheritance& code reusability, Function overriding, Access Specifies- private, public and protected members, Static properties and method, Class constants,Polymorphism,Parent:: &self :: keyword,Instance of operator, Abstract method and class, Interface , Final, Exceptional handling.

(iv) MySQL Installation and Basics

Database Introduction, MySQL installation on various platforms, MySQL connection, Database creation, Database Manipulations- Add, Edit, Retrieve and Delete. Table creation and table manipulations- Add Edit, Retrieve and Delete,LIKE clause, Sorting, Group Functions with having clause

(v) Advance Queries and Data Manipulation using PHPand MySQL

Joins, Handling NULL Values, Regular Expressions, , ALTER Command, Indexes, Temporary Tables, Database Handling Duplicates, SQL Injections. Creating user login form, Registration Form using database, User Authentication, Search, Update, Delete Users and Data. Fetching the data from database

(vi) MVC Infrastructure Basics. PHP frameworks& Introduction to CakePHP

Introduction to MVC, What are Model-View-Controller, Why use framework in the project (conventional vs. MVC project), Introduction to PHP Frameworks i.e. Zend, Codeiginiter, Laravel. Installation of CakePHP, CakePHP folder structure, File naming conventions, Important config file (core.php, database.php)

(vii) Models

Models: What are models and how they interact with database?, Creating up model for a database, Accessing and manipulating table data using find, save, update methods of the model, Deleting Data, User defined functions in model, data validations.

(viii) Controller and Views

Application flow –Creating Controller Function, How Controller interact with model, how controller interact with views. What are CakePHP helpers?, Most commonly used helpers like Form, HTML, Session, Cookie etc, Create views and custom layouts.

(ix)Creating Dynamic Forms using CakePHP Html Helpers:

Introduction to basic html form, get, post methods, Generate form elements like input boxes, dropdowns, radio buttons, and links using CakePHP html helper, Form validation using Model validation definitions, Create, retrieve and delete cookies, Create, retrieve and delete session variables, File handling in CakePHP (create, delete, read files), CakePHP Global variables and their use

2.12.7. Reference Books/Study Material

1. PHP and MySQL Web Development: Publisher: Addison-Wesley Professional Author: Laura Thomson, Luke Welling
2. PHP and MySQL Web Development: Publisher: Addison-Wesley Professional Author: Laura Thomson, Luke Welling
3. Beginning PHP6, Apache, MySQL Web Development Publisher: Wrox Author: Elizabeth Naramore, Jason Gerner, Yann Le Scouarnec, Jeremy Stolz, Michael K.Glass Timothy Boronczyk
4. Learn CakePHP Publisher: Apress Author: Radharadhya Dasa
5. Practical CakePHP Projects Publisher: Apress Author : Miller Cheryl

2.13. Module: A9.4-R5- Data Communication and Networking

2.13.1. Introduction

This course will allow students to develop background knowledge as well as core expertise in networking and data communication technologies, which is one of the fastest growing industries in today's world. It forms an integral part of the modern Information and Communications Technology (ICT) in any organizations. Starting from intranet/extranet in small offices to the World Wide Web, principles of networking and data communication technologies DCN play an important role in designing any modern telecom infrastructure.

A major ramification of the fantastic growth of telecommunications and networking is a dramatic increase in the number of professions, where an understanding of Computer Networking is essential for success. This course is designed with this new mix of students in mind. The course, being the first one on telecommunication and Computer networking in the NIELIT hierarchy, starts from the very basics of communication technology and goes up to the Internet, spanning all the five layers of TCP/IP model. The students will be exposed to communication principles, different types of media, modulation techniques, multiplexing, switched networks, the Internet, TCP/IP suite, network security, mobile wireless communication, fibre-optic communications and the state-of-art networking applications.

2.13.2. Objective

At the end of the course the students would know:

- Strategies for securing network applications in enterprises
- Emerging technologies, such mobile telephony etc. Acquire confidence in using computers Networks, Various transmission media, their comparative study, fibre optics and wireless media
- Categories and topologies of networks (LAN and WAN)
- Layered architecture (OSI and TCP/IP) and protocol suites
- Channel error detection and correction, MAC protocols, Ethernet and WLAN
- Details of IP operations in the INTERNET and associated routing principles
- Operations of TCP/UDP, FTP, HTTP, SMTP, SNMP, etc.

2.13.3. Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.13.4. Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical/ Tutorials) in Hours	Learning Objectives
1. Introduction to Computer Networks	2	3	After completion of this unit the candidate will be able to • Understand the concept of networking, various terminologies used in Networking • Understand various types of Networks, Network topologies • Various modes of communication
2. Introduction: Network layers/Models	4	6	After completion of this unit the candidate will be able to understand • Network layers concepts and its merits and de-merits • Basics of OSI model and TCP-IP protocol suite
3. Physical Layer	2	3	After completion of this unit the candidate will be able to • Understand how data travels physically and understand concepts of signals, transmission modes, switching techniques, various transmission media etc.
4. Data Link Layer	6	9	After completion of this unit the candidate will be able to • Understand function of physical layer, data framing, error detecting codes • DLL-sublayers, Physical layer protocols • Wireless LAN IEEE standards

5. Network layer	6	9	After completion of this unit the candidate will be able to • Understand IP addressing (IPV4,IPV6) • Understand Network layer protocols
6. Transport Layer	6	9	After completion of this unit, the candidate will be able to • Understand function of transport layer and port addressing
7. Congestion Control	4	6	After completion of this unit the candidate will be able to • Understand basics of congestion in network and various congestion control techniques
8. Application Layer	6	9	After completion of this unit, the candidate will be able to • Understand function of application layer and various protocols of this layer
9. Networking devices	4	6	After completion of this unit, the candidate will be able to • Understand the working of various networking devices used in all Network layers
10. Fundamentals of Mobile communication	6	9	After completion of this unit, the candidate will have an overview of Mobile communication and evolution of its generations
Total	48	72	

2.13.5. Marks Distribution

Module Unit	**Written Marks (Max.)**
1. Introduction to Computer Networks	8
2. Introduction: Networks layers/Models	8
3. Physical Layer	10

4. Data Link	10
5. Network Layer	14
6. Transport Layer	14
7. Congestion control	10
8. Application Layer	12
9. Networking Devices	10
10. Fundamentals of Mobile Communication	4
Total	100

2.13.6. Detailed Syllabus

(i) Introduction To Computer Networks

Introduction: Definition of a Computer Network; What is a Network?, Components of a computer network: Use of Computer networks; Networks for companies, Networks for people, Social Issues: Classification of networks; Based on transmission technology, Based on the their scale, Local Area Networks(LANs), Metropolitan Area Networks(MANs), Wide Area Networks(WANs), Computer topologies: Physical vs Logical Topology, Types of topologies: Linear Bus Topology, Ring Topology, Star Topology, Hierarchical or Tree Topology, Topology Comparison, Considerations when choosing a Topology, Modes of communication: Simplex, Half Duplex, Full Duplex, Concept of Channel, Sender and receiver with Communication process

(ii) Introduction: Networks Layers / Models

Protocol hierarchy, Design issues for the layers, Merits and De-merits of Layered Architecture, Service Primitives: Reference models; The OSI Reference Model, The TCP/IP Protocol Model, Comparison of the OSI Reference Model & the TCP/IP Protocol Models: Network standardization; Who's who in the telecommunication world?, Who's who in the standards world, Who's who in the Internet standards world?, TCIP/IP Protocol Suite.

(iii) Physical Layer

Introduction: Basic Functions of Physical Layer, Digital Signals: Bit rate, Bit length, Transmission of digital Signals, Analog Signals: Amplitude, Phase, Frequency, Wavelength, Transmission Impairments, Data Rate limits: Noiseless Channel: Nuyquist Bit Rate, Noisy Channel: Shannon capacity, Performance: Bandwidth, Throughput, Goodput, Latency (delay), Jitter. Concept of Serial and Parallel transmission, Switching; Circuit switching, Message switching, Packet switching, Virtual Switching, Multiplexing; FDM – Frequency division multiplexing, WDM – Wavelength division multiplexing, TDM – Time Division Multiplexing: Synchronous and Statistical,

Transmission Media: Guided Media, Unguided Media, PSTN, Modems, DSL and other standards, Cable Networks: HFC,CM,CMTS.

(iv) Data Link Layer

Introduction, Basic functions of Data Link Layer (LLC and MAC Sublayers): Framinng, CRC, Checksum, Protocols:Stop andWait, Go- Back-N, Selective Repeat, Piggybacking, HDLC, Point to Point, Multiple Access: Random Access :CSMA / CA, CSMA / CD, Controlled Access: Reservation, Polling, Token Passing,Wired LANS: IEEE Standards,Wireless LANs: IEEE Standards.

(v) Network Layer

IPv4 Addressing, IPv4 Subnetting: CIDR,VLSM, NAT, NAT Types, IPv6 Addressing, Transition from IPv4 to IPv6, Address Mapping: ARP, RARP, BOOTP, DHCP, ICMP, ICMPv6 and IGMP, Concept of Forwarding of Packets by Routers, Unicast Routing Protocols: Distance Vector, Link State, Path Vector with examples of each.

(vi) Transport Layer

Introduction, Basic Functions of Transport Layer: Client server Process with Port Numbers concept in detail, Concept of Socket Multiplexing vs Demultiplexing, Connectionless vs Connection Oriented, Reliable vs Unreliable, UDP in detail, TCP in detail.

(vii) Congestion Control

Flow control vs. congestion control. Congestion Basics, Congestion Control: Open-Loop Closed-Loop, Concept of Quality of Service, techniques to improve QoS.

(viii) Application Layer

Basic Function of Application Layer, Concept of Namespace and DNS, Basics of Remote Logging (telnet and ssh), E-mail: Architecture, Introduction to SMTP, POP, IMAP protocols, File Transfer: FTP, Anonymous FTP and TFTP, Concept of www and HTTP: www, http, https protocols, Basics of Network Management System: SNMP protocol

(ix) Networking Devices

Introduction; Goal of networking devices: Repeaters and their use, Hubs, Bridges, Managed vs Non Manageable switches, L-2 Switches, L-3 Switches, Stackable Switches, Concept of Collision Domain, Working of Hubs and Switches, Concept of Port **Density**, Concept of Broadcast Domain, Routers: Dedicated Hardware versus Server-Based Routers, Advantages and Disadvantages of dedicated hardware routers, Drawbacks of Routers, Gateways: Advantages of Gateways, Gateways Functionality, Other Devices: Brouter, Proxy Server, Wireless Access Point (WAPs)/Wireless Router, Wireless LAN Extender and Wireless LAN Controller

(x) Fundamentals of Mobile Communication

Introduction to wireless communication, wireless transmission:frequencies & regularion, signals, antena, multiplexing, modulation, spread spectrum & cellualr system. Evolution of Mobile Generation Technologies: 1G, 2G, 3G, 4G and 5G.

2.13.7. Reference Books/Study Material

1. Introduction to Computer Communication Networks,
2. Andrew S. Tanenbaum, Computer Networks

2.14. Module: A10.4-R5- Information Security Management

2.14.1. Introduction

This module is designed to focus on information security skills and techniques to protect and secure organization's information assets and business systems. Students understand of various types of security incidents, threats and attacks, and learn methods to prevent, detect and react to incidents and attacks.

2.14.2. Objective

This module is designed to focused on information security skills and techniques to protect and secure organization's information assets and business systems. Students understand various types of security incidents, threats and attacks, and learn methods to, detect react and mitigate attacks. After completing the module, the incumbent will be able to:

- Identify different components of network, topology, protocol stacksand devices,
- Able to acquaint with various Information security threats and mitigate such threats /incidents
- Explain the usage of secret key cryptography and public key cryptography, algorithms used in cryptography, and applications
- Understand and identify the common types of attacks against networks and countermeasures
- Identify vulnerabilities in web applications and mitigation strategies
- Identifies the phases of IT audit, performing risk assessment in Windows and Linux environment
- Acquaint with cyber law, incident handling and performing digital forensic analysis

2.14.3. Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.14.4. Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Network Fundamentals	6	9	After completion of this unit the candidate will be able to • Identify different components of a network

			devices. • Identify the different types of network, topologies and the most common network technologies • Understand the properties and functions of network protocols and network protocol stacks
2. Introduction to cyber security and Attacks	6	9	After learning this unit, candidate will be: • Able to acquaint with various Information security threat and controls for it. • To fully understand the Principle of Least Privilege and Confidentiality, Integrity, Availability (CIA), • Conversant in the fundamentals of risk management, security policy, and authentication/authorization/ accountability.
3.Cryptography	10	15	After completion of this unit, candidate will able to • Explain the concepts used in early substitution and translation ciphers • Understand Mathematical concepts underpinning cryptography • Demonstrate the use of hashing in maintaining data integrity • Use encryption methods that ensure both confidentiality and integrity • Understand modern cryptosystem RSA, AES etc. • Understand algorithms used to protect users online and to understand some of the design choices behind these algorithms

4.Network Security and countermeasures	6	9	After completion of this unit, candidate will able to • Understand and know the different types of topologies and the inherent security risks they create • Understand and identify the common types of attacks against networks • Understand the properties and functions of network protocols and the network protocol stacks • Understand the aspect of deploying and utilizing wireless networks and technologies • Configure firewalls, IDS, HIDS, NIDS,NIPS on all platforms for all types of attack scenarios.
5.Web Server and Application Security	4	6	After completion of this unit, candidate will able to • Identify vulnerabilities in web applications, find a way in which the problems could be fixed or avoided. • Learn Mitigation strategies from an infrastructure, architecture, and coding perspective • Learn application coding errors like SQL injection and cross-site scripting • Learn OWASP top 10 vulnerabilities and mitigation techniques.
6.Security Auditing	8	12	After completion of this unit, candidate will be able to • Identifies the phases of IT audit, and how to ensure that

			an audit provides value to the organization. • Learn risk management models exist for implementing a deeper risk management program in their organization. • Learn the elements of risk assessment and the data necessary for performing an effective risk assessment using Microsoft Security Assessment Tool • Learn Linux systems auditing • Perform Risk Assessment based on ISO27001 using ISO27001 security toolkit • Prepare Audit Questionnaire and Performing Audit for ISO27001 Standard
7. Cyber Law and IT Act 2000	4	6	After completion of this unit, candidate will be able to • Know Legal Aspects, Cyber Law – Indian and Internationals perspective • Able to identify types of cybercrimes and penalties associated with the crimes
8. Cyber Forensics	4	6	After completion of this unit, candidate will be able to • Identify source of digital evidence • Know cyber forensics procedure identification, preserving, analysis, authentication presentation • Perform collection, imaging and analysis of the digital evidence • Perform volatile data collection and analysis • Understand the importance of report, maintaining chain of custody

2.14.5. Marks Distribution

Module Unit	Written Marks (Max.)
1. Network Fundamentals	8
2. Introduction to cyber security and Attacks	13
3. Cryptography	16
4. Network Security and countermeasures	16
5. Web Server and Application Security	10
6. Security Auditing	18
7. Cyber Law and IT Act 2000	6
8. Cyber Forensics	13
9. Total	100

2.14.6. Detailed Syllabus

(i) Network Fundamentals

Introduction to Ethernet, OSI layers, TCP/IP models, Functions/ protocols & devices at each layer, Protocol headers for frame, TCP, UDP, IP ,ICMP, applications layers like http, snmp etc,Network Topology, Working of Hub bridge, switch, router, UTM, remote administration of and managed network devices, Types of Networks, VLAN, Subnetting, NAT Working with Number systems, Fixed Length subnet masking, Variable Length subnet, masking, Classless Inter Domain Routing, Inter VLAN routing, Static Routing, RIP, RIPv2, OSPF, EIGRP, IGRP using IPv4, Routing in Ipv6.

(ii) Introduction to cyber security and Attacks

Fundamentals of information security - CIA Triad, Cyber Security Controls, Logical Controls, Physical Controls, Tools & Techniques, understanding threats, attacks categories, hacking process, Vulnerability, Threat & Risk (with examples), Types of Attacks (DDOS, Phishing, Malware etc. with examples), Threats at Client systems (malware, social engineering, open ports, etc.) Threats to Network, Web, Storage & Devices, Understanding the network security, Mitigation Techniques, fundamental of web/mobile application security, Web Application Attacks (SQL Injection, Cross site scripting etc.), Mobile Application Attacks, data center security, cloud computing and data security.

(iii) Cryptography

Data Transmission and Organization, error detecting and correcting codes, need of cryptography. Cryptology fundamentals, Symmetric-Asymmetric cryptography & cryptographic algorithms, Private key encryption, Public key encryption, Protocols, Key management, including key generation, key storage, Key exchange, Encryption folders(Graphical/ using cipher), Data recovery agent, Symmetric key encryption algorithm, DES/3DES, IDEA,RC5, AES, Public key algorithm, RSA & ECC, Diffie-Hellman key exchange, Hash functions, MD5-message digest algorithm, SHA-1 Secure Hash algorithm, HMAC, Applications of cryptography- Secure Email PGP, SSL TLS S/MIME, File Encryption IPsec, IOT Attacks against encryption, Public Key Infrastructure Understanding digital certificates and signatures.PKI Standards and Management, X.500, X.509, ETF, IRTF.

(iv) Network Security and countermeasures

Securing Networks, Network security devices– Router, ACL, firewalls, types of firewalls, configuration and deployment, overview of IDS, Network-based IDS (NIDS), Host-based IDS, Overview of IPS, Host-based IPS, (HIPS), Network-based IPS(NIPS), UTMTMG threat management gateway, network security tools (scanners, sniffers etc) and Countermeasures. wireless security, securing wireless networks: wireless overview,Bluetooth, 820.11

(v) Web Server and Application Security

Client-Server Relationship, Vulnerabilities in web server and applications, Attack methods, Buffer overflow, SQl injection, cross site scripting, session hijack etc., Secure Coding Practices, OWASP top 10 vulnerabilities and mitigation techniques, Web Application vulnerability scanning, tools (Nesus), Web application security challenges

(vi) Security Auditing

Audit planning (scope, pre-audit planning, data gathering, audit risk), Risk management, Overall Audit Risk, Risk based approach, Evidence, Evidence gathering techniques, Sampling, Control Self-Assessment, Risk analysis, Purpose of risk analysis, Risk based auditing, Types of Control, Risk Assessment using Simple Risk or Eramba (Open source Tools), 3 phase approach – Risk assessment IT/IS Audit, Log analysis, Using Microsoft Security Assessment Tool, Using Microsoft Security Baseline Analyzer, Configuring Windows File system auditing. Event ID Log Analysis, OS and Application specific auditing, Performing Risk Assessment based on ISO27001 using ISO27001 security toolkit, Preparing Audit Questionnaire and Performing Audit for ISO27001 Standard.

(vii) Cyber Law and IT Act 2000

Information Technology Act 2000 (as amended in 2008), Rules under Information Technology Act 2000. The Rule of Cyberspace .Cyber Law – Policy Issues and Emerging Trends Online Contract. Digital Signature Cyber Crime, DataProtection, Liability of Intermediary, Copyright and Internet.Domain Name Dispute,Harmful content in Internet,Case Studies.

(viii) Cyber Forensics

Digital Evidence, identification of digital evidence, Cyber forensics Processes Identification, Preservation, seizure and acquisitions, Analysis, authentication and presentations, fundamental of Incident response and handling, Reporting, mitigation, Volatile evidence collection and analysis, disk imaging and analysis, Investigating Information-hiding, analysis of e-mail, Tracing Internet access, Understanding importance of report, writing of reports, generating report finding with forensics tools, Chain of custody forms, Laboratory documents and procedures.

2.14.7. Reference Books/Study Material

1. Cryptography and Network Security Principles and Practices, William Stallings,Seventh Edition,Pearson
2. Network Security Essentials: Applications and Standards Paperback, William Stallings
3. Cryptography and Network Security Paperback, Atul Kahate
4. Computer Networks, 5e (5th Edition) Paperback, Tanenbaum
5. Principles of Computer Security: CompTIA Security+ and Beyond, W.A.Coklin, G.White, Fifth Edition.
6. Cyber Law-Law ff Information Technology And Internet Paperback, Anirudh Rastogi
7. Hands-on Incident Response and Digital Forensics, Jason Wayne

2.15. Module: A9.5-R5- Internet of Things: A Practical Approach

2.15.1. Introduction

The module is designed to equip the students to understand the advanced concepts of Internet of Things (IoT) and its applications. The Internet of Things (IoT) is expanding at a rapid rate, and it is becoming increasingly important for professionals to understand what it is, how it works, and how to harness its power to improve business. This introductory course will enable learners to leverage their business and/or technical knowledge across IoT-related functions in the workplace.

In the course, we will examine the concept of IoT. We will look at the 'things' that make up the Internet of Things, including how those components are connected together, how they communicate, and how they value add to the data generated. We will also examine cyber security and privacy issues, and highlight how IoT can optimize processes and improve efficiencies in your business.

2.15.2. Objective

After completing the module, the incumbent will be able:

- To assess the vision and introduction of IoT.
- To Understand IoT Market perspective.
- To Implement Data and Knowledge Management and use of Devices in IoT Technology.
- To understand state of the art - IoT Architecture.
- To understand IoT hardware platform and interfacing strategies.
- To classify Real World IoT Design Constraints IoT and Modern IoT
- To understand security threats in IoT

2.15.3. Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.15.4. Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Hardware platform for Prototyping IoT applications	10	18	• Embedded Microcontrollers • Hardware platform for prototyping IoT • Open IDE for application development

2. Sensors, Actuators and its interfacing	10	17	• The sensor & Actuator principles • The Embedded bus protocols • Modern sensors, actuators and their interfacing strategies
3. IoT - Networking & Protocols	8	10	• The communication protocols • Layering concepts • IP Addressing • IoT Application protocols
4. Webserver basics for IoT	10	15	• Webserver overview • client server model • Embedded web servers for IoT
5. The IoT database management & Cloud connectivity	6	6	• The need for IoT database management • sql and nosql based tools • Basics of cloud computing • Public and private cloud for IoT Application development
6. Security for next Generation IoT, IIoT	4	6	• Current security issues for IoT • Future security threats for IoT • Penetration of Modern trends -IIoT

2.15.5. Marks Distribution

Module Unit	Written Marks (Max.)
1. Hardware platform for Prototyping IoT applications	20
2. Sensors, Actuators and its interfacing	20
3. IoT - Networking & Protocols	20
4. Webserver basics for IoT	15
5. The IoT database management & Cloud connectivity	15

6. Security for next Generation IoT , IIoT	10
Total	100

2.15.6. Detailed Syllabus

(i) Hardware Platform for Prototyping IoT Applications:

Open IoT hardware platforms: ESP8266 - Architecture, Peripherals, NodeMCU architecture, Features, and its peripherals, pin diagram.

Open Embedded IDEs: Ardunio IDE, familirisation and setting up for NodeMCU/ESP8266, Enabling libraries for application development.

Programming : Overview of Arduino programming and interfacing

(ii) Sensors, Actuators and its Interfacing :

Sensors & Actuators : The priciple of Sensing & Actuation, The sensors for IoT Applications, The operating priciples of sensors & Actuators, Analog & digital sensors.

The interfacing priciples: Analog to Digital Converters, Sampling theory, ADC Classification, Digital to Analog converters.

Protocols and its designs: I2C ,SPI and CAN, Modern sensors interfacing with bus protocols.

Interfacing Sensors-Actuators: Interfacing digital and analog sensors with NodeMCU, Interfacing Actuators with NodeMCU

(iii) IoT - The Networking & Protocols :

Overview: Network layer architecture, communication model, Introduction to Application layer protocols - http, https, telnet, ftp, Connection oriented vs Connection less protocols, Basics of IP Addressing.

The IoT application protocols- MQTT, COAP, Its Applications.

IoT physical layer connectivity solutions:WiFi, Bluetooth, Zigbee, Sub1Ghz

Connecting IoT devices using IPv4 and IPv6 protocol.

(iv) Webserver Basics for IoT

Web servers: Socket and client basics, http, https servers, Web sockets

Apache servers- Installation & familiarization, Configuring and personalizing webservers.

Webserver -Tools, scripts & Languages: HTML basics- personalizing websites, creating buttons and text boxes on web pages. REST services, GET&POST methods, overview of CSS, JSS, PHP for modern webservers.

Embedded Web server localisation: Intranet vs Internet access, Development of local webserver using NodeMCU for remote monitoring, development of

remote webserver for actuator application. Developing Embedded client & server model with NodeMCU.

MQTT servers: MQTT broker, client basics, publishing and subscribing data, Publish and subscribe using open brokers.

(v) The IoT Database Management &Cloud connectivity - Public & Private:

Database management: mysql, mysql database creation, creation of remote and its database access.nosql based tools and its application.

Overview of cloud: Cloud computing introduction, functioning of cloud computing, cloud architecture, cloud storage and services, Industrial applications.

Discovery of Private and Hybrid Clouds- Introduction- Objectives, 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 Offering.

IoT cloud services: Private and public cloud for IoT, working principle, Features and comparisons.

IoT cloud case studies: Thing speak cloud service, pushing data to thing speak from NodeMCU, developing smart environment monitoring and update to Thingspeak or open cloud.

(vi) Security for Next Generation IoT, IIoT

Current Security & privacy Issues: Password Complexity, Account Enumeration, Secure Communication, Hardware / OTA - Over the Air communication, Cloud server security, IoT Privacy, IoT Ethics and Legal issues

Penetration of Modern Technologies: Introduction to Industrial IoT, Security and privacy issues.

2.15.7. Practical/Use-cases

1. IoT – Networking and Protocols
   a. Familiarization of Network Devices in Detail.
   b. Familiarization of network IP and its configuration, classification.
   c. Connect the computers in Local Area Network and configure IP, identify basic network command and Network configuration commands.
   d. Setup WAN Connections
   e. Interpreting Ping, ARP and Traceroute Output

2. Use of IoT in Automated Hydroponics System
   The case study based on use of IoT in automated Hydroponics System is to be discussed.

3. Familiarization of Arduino for NodeMCU

a. This use case will be used for familiarizing the library and the board setup of NodeMCU using Arduino IDE.

b. This use case will help to understand the GPIO, serial peripherals of NodeMCU. GPIO will tested in two different modes, Input - Button and LED - output mode.

Interfacing Light Dependent Resistor (LDR) and LED, displaying automatic night lamp

c. This use case will help to understand ADC peripheral and how to read analog data from sensors.

Interfacing Temperature Sensor(LM35) and/or humidity sensor (e.g. DHT11)
Interfacing Liquid Crystal Display(LCD) – display data generated by sensor on LCD

d. This case study will demonstrate how to provide local display unit with Arduino micro controller. use suitable libraries for implementing this case studies.

2.15.8. Reference Books/Study Material

1. Macro Schwartz, Macro Schwartz, "Internet of Things with ESP8266", Open Home Automation.
2. Arshdeep Bagha and Vijay Madisetti, "Internet of Things- A Hands-on Approach" Universities Press, 2014.
3. David Hanes, Gonzalo Salgueiro, and Patrick Grossetete "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things"
4. Michael Margolis, "Arduino Cookbook", Oreilly, 2011
5. Catalin Batrinu "ESP8266 Home Automation Projects", Packt

2.16. Module: A10.5-R5- Internet of Things using Raspberry Pi

2.16.1. Introduction

The module is designed to make students understand the basics of Single Board Computer(SBC) specifically Raspberry Pi. The purpose is for installation, configuring and using Raspberry Pi in different verticals in the connected world of Internet of Things (IoT).

The genesis of this module lies around open source hardware/software. The file system and other basics of Linux operating system is discussed with respect to Raspberry Pi, along with installing and configuring new software. Raspberry host bundle of open source software and are being discussed in this module such as python programming language, interfacing hardware (GPIO programming) through C-language using wiringPi library. Visual programming editor Node-RED makes easy for novice to expert level programmer to interface hardware using easy flow based programming.

This module provides the theoretical and practical aspects of installing different software on Raspberry Pialong with interfacing sensors, storing and/or publishing data over Cloud. Configuring software to make web server run on Raspberry Pi.

2.16.2. Objective

After completing the module, the incumbent will be able to:

- Know the history, uses and applications of Single Board Computer(SBC) - *Raspberry Pi*
- Install and Configure operating system on Raspberry Pi
- Know basics of Linux operating system and its file system
- Understand basic Linux shell commands to install new hardware and/or software
- Write GPIO based programs using embedded 'C' Language and Python Language
- Understand WiringPi and BCM pinout
- Interface sensors with Raspberry Pi
- Visual programming/ flow-based programming in Node-RED
- Develop IoT applications using Raspberry Pi as central gateway connecting to Cloud.

2.16.3. Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.16.4. Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Introduction to Single Board Computer – Raspberry Piand other target platforms	6	9	After completion of this unit of module, the candidate will be able to • Understand the need and use of Single Board Computer-Raspberry Pi • Know the uses of Raspberry Pi in IoT ecosystem • Comparing available SBCs in the market
2. Configuring and Managing Raspberry Pi	6	9	After completing this unit, learner will be able to understand • Select appropriate Raspberry Pi and its accessories • Operating System distribution- NOOBS, Raspbian • Uses of raspi-config command • Configuring Network-wired, wireless.
3. Linux Operating System Basics	10	15	After completing this unit, learner will be able to understand • Linux file system • Writing shell scripts • Use of pipes, redirection
4. Hardware interfacing - GPIO programming	14	21	After completing this unit, learner will be able to understand • GPIO pins • WiringPi, BCM pinout

			• Controlling hardware – input/output • Python language basics • Python lists and dictionaries • Web access from Python
5. Raspberry Pi based IoT application use-cases	12	18	After completing this unit, learner will be able to understand • Configuring web server on Raspberry Pi • Controlling GPIO pins from web browser • Display sensor values on web page • Configure Apache-MySQL-PHP • Pushing data to public and/or private web server. • Programming with Node-RED

2.16.5. Marks Distribution

Module Unit	Written Marks (Max.)
1. Introduction to Single Board Computer – Raspberry Pi	15
2. Configuring and Managing Raspberry Pi	15
3. Linux Operating System Basics	20
4. Hardware interfacing - GPIO programming	25
5. Raspberry Pi based IoT application use-cases	25
Total	100

2.16.6. Detailed Syllabus

(i) Introduction to Single Board Computer – Raspberry Pi and programming language Python

Introduction –Single Board Computer(SBC) History, Architecture, working, characteristics, applications/ use-cases, Introduction to SoC.

Introduction to programming through Python:

Python Basics – Python IDE – IDLE, variables, input/output, operators, strings, control statements, loops, functions, Modules, Packages.

Python List and Dictionaries – creating, accessing, iterating, enumerating, sorting.

(ii) Configuring and Managing Raspberry Pi

Understand Raspberry Pi family - Selecting the model of Raspberry Pi, power supply, operating system distribution- NOOBS, raspbain, preparing operating system on SD-card.

Using raspi-config command –change password, boot options, configure camera, etc.

Networking – connecting to wired or wireless network

(iii) Linux Operating System Basics

Introduction –using Terminal to access Filesystem, creating, moving, deleting files/folders, Privileges/file permissions, ownership, apt-get, pip

Shell scripting – understanding and writing shell scripts, running scripts/command in background, creating aliases, pipes, running program or script automatically - on startup, as a service, at regular intervals.

(iv) Hardware interfacing - GPIO programming

Introduction–General Purpose Input Output(GPIO) pins, understanding WiringPi, BCM pinout, classification of pins- I2C, SPI, UART, digital/PWM

Controlling Hardware – Connecting LED, Buzzer, DC Motor, Digital Inputs-button/push switch, toggling, debouncing, keypad, etc. Interfacing sensors-light, temperature, humidity, gases, etc. LCD interfacing.

WiringPi – programming digital I/O's using WiringPi (C language) library. Arduino-styled programming for Raspberry Pi.

Advanced programming using Python– file handling, making web Requests from python, running Linux commands from python

Python packages of Interest for IoT – JSON, XML, HTTPLib & URLLib

(v) Raspberry Pi based IoT application use-cases

Web Server– simple python web server e.g. bottle, for controlling GPIO outputs through web.

Display sensor readings on a web page.

Configuring Apache-MySQL-PHP stack, to install WordPress.

Sending data to public and/or private web server.

Introduction to Node-RED – Using Node Red to make MQTT dashboard

2.16.7. Use-case for building IoT based application Using Raspberry Pi

i. Interfacing Light Emitting Diode(LED) and switch/button with Raspberry Pi:

This use case will familiarize the Raspberry Pi - GPIO pins and control the pins from command and Python program.

ii. Interfacing Temperature Sensor(LM35) and/or humidity sensor (e.g. DHT11)

This use case will display the value of sensor on the webpage hosted on web server configured on Raspberry Pi.

iii. IoT based Weather Monitoring Station

This use-case will help to understand the working of Weather Monitoring Station which collect data of environmental conditions such as pressure, temperature, pressure, humidity and light from multiple end nodes. Raspberry Pi collects the data send by these ends nodes and further aggregates and analyzes.

iv. Smart Lighting / Home Automation

This case study will demonstrate controlling lights using MQTT and/or REST services.

v. Smart Parking

This use-case will demonstrate smart Parking using ultrasonic sensor. The ultrasonic sensor on the roof of parking area will send the occupancy status to central server-Raspberry Pi. The dashboard running on Raspberry Pi will display the complete occupancy status of parking lot and/or publish the same status on Cloud.

vi. Smart Irrigation

This use-case will demonstrate smart irrigation using soil moisture sensors. The soil moisture sensor determines the amount of moisture in the soil and release the flow of water. The water flow in pipes used for irrigation is controlled using solenoid valves. When moisture level crosses threshold value, valve is opened to

release flow of water. The moisture level, solenoid valve operation(on/off) is stored and analyzed in Raspberry Pi.

2.16.8. Reference Books/Study Material

1. Simon Monk, "Raspberry Pi - Cookbook", 2nd Edition,Oreilly 2017
2. Maneesh Rao "Internet of Things with Raspberry Pi 3 : Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects" Packt
3. Arshdeep Bahga and Vijay Madisetti, "Internet of Things- A Hands-on Approach" Universities Press, 2014
4. Sai Yamanoor and Srihari Yamanoor, "Python Programming with Raspberry Pi", Packt
5. From The makers of The MagPi, "The official Raspberry Pi Projects Book volume 3", link: https://www.raspberrypi.org/magpi-issues/Projects_Book_v3.pdf

2.17. Module: A9.4-R5 –Artificial Intelligence Concepts and R Programming

2.17.1. Introduction

Artificial Intelligence is the intelligence exhibited by machines or software. The application areas of artificial intelligence is very vast and so this is a field of study which is gaining importance day by day. This branch of engineering emphasizes on creating intelligent machines that work and react like humans. There are different dimensions for artificial intelligence, in which the decision taking capacity is most important.

2.17.2. Objective

At the end of the course the students will be able to

- Identify the scope and limits of the Artificial Intelligence (AI) field.
- Analyze the application areas of Artificial Intelligence.
- Explore data, process it and make it ready for developing AI based systems.
- Apply R programming for data preparation, data exploration& visualization
- Apply Probability and Statistics for solving problems in real life.
- Apply R programming tool to obtain results of statistical data analysis problems.

2.17.3. Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.17.4. Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Introduction to Artificial Intelligence	6	4	After completion of this unit the candidate will be able to • Describe the building blocks of AI Systems. • List the environment and goals of agent based systems and draw the design of an Agent.
2. Applciations of AI	4	6	After completion of this unit the candidate will be able to • Identify the suitability of applying AI as a solution, based on context of applications.

3. R Programming & Statistical Data Analysis	20	32	After completion of this unit the candidate will be able to • Write R programs and use its various data structures for data preparation and exploration. • Do data visualization using R. • Solve problems involving probability and do statistical data analysis using statistics and probability distribution methods.
4. Data Preparation and Machine Learning Basics	18	30	After completion of this unit the candidate will be able to • grab raw data, clean it and make it ready for building machine learning models. • Identify the suitable task to be performed on data for useful model development. • Apply suitable algorithm on the data to develop models. • Use suitable metrics to analyse the performance of ML models.
Total	48	72	

2.17.5. Marks Distribution

Module Unit	Written Marks (Max.)
1. Introduction to Artificial Intelligence	10
2. Applciations of AI	10
3. R Programming& Statistical Data Analysis	40
4. Data Preparation and Machine Learning Basics	40
Total	100

2.17.6. Detailed Syllabus

(i) Introduction To Artificial Intelligence

Introduction to Artificial Intelligence (AI), history of AI. Advantages of AI, need for AI for modern applications, Intelligent agents, structure of Agents, agent program: goal based agents, utility based agent, learning agents, agent environment, multi agent systems, components of intelligence. Foundations of AI based Systems.

Introduction to Business Intelligence, Business Analytics, Data, Information, how information hierarchy can be improved/introduced, understanding Business Analytics, Introduction to OLAP, OLTP, data mining and data warehouse. Difference between OLAP and OLTP. Use of AI in data analytics.

(ii) Applications of AI

Applications of AI, health care sector, finance sector, smart cars, devices and homes, travel and navigations, entertainment, security, automation, automobile industry.

(iii) R Programming

R Programming: Basics - Vectors, Factors, Lists, Matrices, Arrays, Data Frames, Reading data.

Data visualization –barplot, pie, scatterplot, histogram, scatter matrix.

(iv) Statistical Data Analysis

Statistical data analysis –Summary Statistics, Correlation and Regression, Probability distributions- Normal distribution, Poisson distribution, Binomial distribution

Types of data- Structured, Unstructured and Semi structured data.

(v) Data Preparation and Machine Learning Basics

Learning Systems. Supervised and Unsupervised Learning. Tasks performed by Machine Learning Algorithms – Classification, Regression, Clustering, Association rule Mining. Linear Regression, K-Nearest Neighbor Classifier, K-Means Algorithm. Performance evaluation metrics of machine learning algorithms- Accuracy Score, Confusion Matrix, Root Mean Squared Error.

2.17.7. Reference Books/Study Material

1) R for Everyone By Jared P. Lander
2) Artificial Intelligence- Reshaping Life and Business by Prabhath Kumar

2.18. Module: A10.4-R5- Artificial Intelligence Using Python

2.18.1. Introduction

The course would cover the spectrum of data analytics, machine learning, deep learning, natural language processing and computer vision. The student would dive straight into data analytics and applied machine learning and deep learning algorithms.

2.18.2. Objective

At the end of the course the students will be able to

- Solve real world problems through machine learning implementation leading to predictions.
- Understand various learning models, methods and applications under supervised and unsupervised learning.
- Use NLTK Library which helps in text analytics.

2.18.3. Duration

120 Hours - (Theory: 48 hrs + Practical: 72 hrs)

2.18.4. Outline of Module

Module Unit	Duration (Theory) in Hours	Duration (Practical) in Hours	Learning Objectives
1. Advanced Python	14	21	After completion of this unit, candidate will be able to do • Scientific computing and data analysis by understanding multi-dimensional arrays, data frames and analysis functions. • Make various types of Graphs and Plots using Python Graphical libraries.
2. Machine Learning	16	24	After completion of this unit, candidate will be able to • Solve problems through machine learning implementations leading to predictions. • Learn the evaluation and accuracy of various

			algorithms.
3. Computer Vision	6	9	After completion of this unit, candidate will be able to write programs using machine learning algorithms in opencv for detection and recognition of images.
4. Deep Learning	8	12	After completion of this unit, candidate will be able to • Learn to train and implement deep learning algorithms. • Understand the implementation of AI through real world examples of images.
5. Natural Language Processing	4	6	After completion of this unit, candidate will be able to understand the concepts of NLP and process linguistic data using the popular algorithms.
Total	48	72	

2.18.5. Marks Distribution

Module Unit	Written Marks (Max.)
1. Advanced Python	32
2. Machine Learning	36
3. Deep Learning	12
4. Computer Vision	10
5. Natural Language Processing	10
6. Total	100

2.18.6. Detailed Syllabus

(i) Advanced Python

Overview of Python language, Programming Constructs, Data Structures like lists, dictionaries, tuples, sequences and their manipulations. Python Functions.

Modules And Packages, Exception Handling, NumPy Library, Broadcasting and numpy functions. Pandas Library, Working with dataframes, Loading csv, manipulating dataframes, Aggregation functions, Analysis. Visualization using matplotlib and Seaborn.

(ii) Machine Learning

Categories of ML, Supervised, Unsupervised, Reinforcement, Semi-Supervised. Supervised Learning Models, Regression, Classification, Naive Bayes, Support Vector Machines, Decision Trees, K-nearest Neighbours, Ensemble Methods of Classification, Machine Learning Evaluation Metrics, Cross Validation.

(iii) Computer Vision

Introduction to Computer Vision, Face Recognition and Detection with OpenCV, Face Recognisers, Training data, Prediction.

(iv) Deep Learning

Artificial Neural Networks and Model, ANN structure, Feed Forward Neural network, Back Propogation, Deep Learning Concepts, Convolutional Neural Network (CNN), Neural Network using Tensorflow.

Learning Algorithms, Error correction and Gradient Descent Rules, Perceptron Learning Algorithm.

(v) Natural Language Processing

Basics of text processing, Lexical processing, NLP tasks in syntax, semantics, and pragmatics. Applications like Automatic Summarization, Sentiment Analysis and Text Classification.

2.18.7. Reference Books/Study Material

1. Simon Monk, "Raspberry Pi - Cookbook", 2nd Edition,Oreilly 2017
2. Machine Learning an algorithmic Perspective by Stephen Marshland
3. Programming in Python by Mark Summerfield
4. Learning Python By Mark Lutz, David Ascher
5. Introduction to Machine Learning with python by Andreas C Muller, Sarah Guido