Minutes of Meeting

Board of Studies of Centre for Internet of Things

B.Tech Internet of Things

30 May, 2024

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(Deemed to be University
Declared Under Distinct Category by Ministry of Education, Government of India
Centre for Internet of Things

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(Deemed to be University)
(Declared Under Distinct Category by Ministry of Education, Government of India)
NAAC Accredited with A++ Grade

Centre for Internet of Things

Date: 31-05-2024

Summary

(Approved by Academic Development Cell of the institute - BoS Meeting scheduled on 30th May 2024)

Courses where revision was carried out*

(Course/subject name)	Course Code	Year/ Date of Introduction	Year/ Date of revision	Percentage of content added or replaced	Agenda Item No.	Page No.	Link of relevant documents/minutes
Advanced IoT Applications	220702	2023/ 01.07.23	2024/ 30.05.24	5%	04		Click here
Cloud Computing	2220502	2022/ 01.07.23	2024/ 30.05.24	10%	09		Click here
Data science in IoT	2220505	2022/ 01.07.23	2024/ 30.05.24	10%	09		Click here

Courses focusing on employability/entrepreneurship/ skill development*

(Course/subject name)	Course Code	Activities/contents which have a bearing on increasing skill and employability	Agenda Item No.	Page No.	Link of relevant documents/minutes
Data Sciences in IoT	2230522	Learn to analyze IoT-generated data, driving smart solutions and boosting career prospects in emerging technologies.	09		Click here
Smart Energy Analytics	220701	Develop technical skills in energy data analysis and practical experience with smart grid technologies, for in-demand roles in the evolving energy sector.	04		Click here

Advanced IoT Applications	220702	Enhances skills in IoT system design, Practical experience in IoT.	04		Click here

New Courses added*

(Course/subject name)	Course Code	Activities/contents which have a bearing on increasing skill and employability	Agenda Item No.	Page No.	Link of relevant documents/minutes
Electronic Systems Thinking & Circuits	2220305	Develop skills in designing, analyzing, and troubleshooting electronic circuits. Engage in hands-on projects and simulations, enhancing problem-solving abilities and employability in electronics and engineering sectors.	14		Click here
Advanced Engineering Measurements		Develop skills of various measurement techniques and tools, including statistical analysis and error propagation for sensors in electrical, electronic and mechanical systems.	09		Click here

Feedback on curriculum received from stakeholders: Analysis& ATR*

Stakeholder	Student	Faculty	Alumni	Employer
No. of Responses	1st Sem: 111 3rd Sem: 54 5th Sem: 56 7th Sem: 29	22	--	--
Link of Analysis	Click Here	Click Here	--	--
ATR Link	Click Here	Click Here	--	--
Link showing Excel sheet of Google Form details of stakeholder	Click Here	Click Here	--	--

Minutes of Meeting Board of Studies

Board of Studies (BoS) meeting of the Centre for Internet of Things was held in hybrid mode on **May 30th, 2024 at 03:00 PM onwards**. The following external members were invited in addition to the faculty members of the department:

S.No.	Name of Expert	Designation and Organization
➢	Dr. Narendra Kumar -1 ***(Vice-chancellor , Nominee)***	Professor, Department of Electrical Engineering, **DTU-Delhi**
➢	Mr. Paurush Godhar, ***(Industry expert)***	**Manager**, Strategy & Consulting-Accenture
➢	Er. Shubham Sharma, **(Alumus)**	Engineers Control, **General Electric** Bangluru
➢	Dr. Anmol Ratna Saxena, ***(Subject Expert)***	Associate Professor, **NIT-Delhi**
➢	Dr. Prakash Chittora, ***(Subject Expert)***	Assistant Professor, DTU

Above mentioned External experts and the following Internal members attended the meeting:

1. **Dr. Praveen Bansal,** Assistant Professor & Coordinator, CoT
2. **Dr. Dhananjay Bisen,** Assistant Professor
3. **Dr. Aditya Dubey,** Assistant Professor
4. **Dr. Priyanka Garg**, Assistant Professor
5. **Dr. Yashwant Sawle**, Assistant Professor
6. **Dr. Nookala Venu**, Assistant Professor
7. **Dr. Saurabh Kumar Rajput**, Assistant Professor
8. **Dr. Bhavna Rathore**, Assistant Professor
9. **Dr. Kaushal Pratap Sengar**, Assistant Professor
10. **Dr. Murli Manohar,** Assistant Professor
11. **Dr. Gaurav Khare,** Assistant Professor

Agenda-wise Summary of BoS Meeting

Item CIoT1	**To confirm the minutes of previous BoS meeting held in the month of December 2023** ➢ *The minutes of the last BoS held on December 1st, 2023 at 03:30 PM were confirmed. The BoS Minutes were presented & approved in Academic Council Meeting held on 14th December 2023*
Item CIoT2	**To review and finalize the scheme structure of B.Tech. VII Semester with the provision of Three (03) Departmental Electives (DEs) and Open Category (OC) Course. (Out of which One (01) Elective and o1 Open category course is to be offered in traditional mode and remaining Two (02) Departmental Electives are to be offered in online mode with credit transfer for the batch admitted in 2021-22.** ➢ *The scheme structure of B. Tech. VII Semester of Internet of Things for the batch admitted in 2021-22 is prepared and is annexed at **ANNEXURE-1***
Item CIoT3	**To propose the list of courses which the students can opt from SWAYAM/NPTEL/MOOC based Platforms, to be offered in online mode for Two (02) Departmental Electives (DE) Course, with credit transfer in the B.Tech. VII Semester under the flexible curriculum (Batch admitted in 2021-22)** ➢ *List of offered DE and OC courses in online is annexed at **ANNEXURE-2***

Details of Departmental Elective (DE-3): SWAYAM/NPTEL/MOOC

Course Name	Code	Offered By	Duration of the course	Start date	End date	Exam date	Name of the Mentor faculty
220757	Pattern Recognition and Application	IIT Kharagpur	12 Weeks	July 22, 2024	October 11, 2024	October 27, 2024	
220758	Getting Started with Competitive Programming	IIT Gandhinagar	12 Weeks	July 22, 2024	October 11, 2024	October 27, 2024	
220759	Programming in Java	IIT Kharagpur	12 Weeks	July 22, 2024	October 11, 2024	October 27, 2024	

220760	Big Data Computing	IIT Patna	8 Weeks	August 19, 2024	October 11, 2024	October 26, 2024	

Details of Departmental Elective (DE-4): SWAYAM/NPTEL/MOOC

Course Name	Code	Offered By	Duration of the course	Start date	End date	Exam date	Name of the Mentor faculty
220761	The Joy of Computing using Python	IIT Ropar	12 Weeks	July 22, 2024	October 11, 2024	November 2, 2024	
220762	Deep Learning - IIT Ropar	IIT Ropar	12 Weeks	July 22, 2024	October 11, 2024	November 2, 2024	
220763	Smart Grid: Basics to Advanced Technologies	IITR	12 Weeks	July 22, 2024	October 11, 2024	November 3, 2024	

Item CIoT4

To prepare and finalize the syllabus of courses to be offered (for batch admitted in 2021-22)under Departmental Elective (DE) Course (in traditional mode) for B. Tech. VII Semester along with their COs

- *The syllabus of B. Tech. VII Semester of Internet of Things for the batch admitted in 2021-22 is prepared and is annexed at **ANNEXURE-3***

Code	Course Name
220701	Smart Energy Analytics
220702	Advanced IoT Applications

Item CIoT5

To prepare and finalize the syllabus of courses to be offered (for batch admitted in 2021-22) under the Open Category (OC) Courses (in traditional mode) for B.Tech. VII semester students of other departments along with their Cos.

- *The syllabus of B. Tech. VII Semester of Internet of Things for the batch admitted in 2021-22 is prepared and is annexed at **ANNEXURE-4***

Code	Course Name
910226	Smart Energy Analytics
910203	IoT and its Applications

Item CIoT6

To review and finalize the Experiment list/ Lab manual for Departmental Laboratory Course (DLC) to be offered in B. Tech. VII semester (for batches admitted in 2021-22)

- *The Experiment list/ Lab manual for various laboratory courses to be offered in along with the Course Outcomes of VII semester of the B.Tech Internet of Things students of 2021-22 admitted batch under the flexible curriculum is included at **ANNEXURE-5***

Item CIoT7

To propose the list of "Additional Courses" which can be opted for getting an

(i) Honours (for students of the host department)

(ii) Minor Specialization (for students of other departments)

These will be offered through SWAYAM/NPTEL/MOOC based Platforms for the B.Tech. VII semester students (for the batch admitted in 2021-22) and for B.Tech. V semester (for the batch admitted in 2022-23).

- *The Details is also annexed as **ANNEXURE-6***

(i) Following courses are identified & proposed for **V Semester** for their requirement towards getting **Honors**

SN	Course Name	Offered By	Duration of Course	Exam Date
1.	Practical Cyber Security for Cyber Security Practitioners	IIT Kanpur	12 Weeks	October 26, 2024
2.	Introduction to Graph Algorithms	IISc Bangalore	8 Weeks	September 22, 2024
3.	Programming, Data Structures and Algorithms using Python	Chennai Mathematical Institute	8 Weeks	September 22, 2024
4.	Deep Learning for Computer Vision	IIT Hyderabad	12 Weeks	October 26, 2024
5.	Social Network Analysis	IIT Delhi	12 Weeks	October 26, 2024
6.	C-Based VLSI Design	IIT Guwahati	12 Weeks	November 3,

				2024
7.	Data Structure and Algorithms using Java	IIT Kharagpur	12 Weeks	October 26, 2024
8.	Algorithmic Game Theory	IIT Kharagpur	12 Weeks	October 27, 2024
9.	Responsible & Safe AI Systems	IIIT Hyderabad and IIT Madras	12 Weeks	November 2, 2024
10.	Introduction to Semiconductor Devices	IIT Hyderabad	12 Weeks	October 26, 2024
11.	Analog Communication	IIT Kharagpur	12 Weeks	November 2, 2024
12.	Real-Time Digital Signal Processing	IISc Bangalore	12 Weeks	November 2, 2024

(ii) Following courses are identified & proposed for **VII Semester** for their requirement towards getting **Honors**

S. No	Tracks	Course Name	Offered By	Duration of Course	Exam Date
1.	Artificial Intelligence	Responsible & Safe AI Systems	IIIT Hyderabad and IIT Madras	12 Weeks	November 2, 2024
2.		Introduction to Machine Learning	IITM	12 Weeks	October 27, 2024
3.		Artificial Intelligence : Search Methods For Problem solving	IIT Madras	12 Weeks	October 26, 2024
4.		Artificial Intelligence for Economics	IIT Kharagpur	8 Weeks	September 13, 2024

1.	Computational Techniques	Data Structure and Algorithms using Java	IIT Kharagpur	12 Weeks	October 26, 2024
2.		Programming in Modern C++	IITKGP	12 Weeks	November 3, 2024
3.		Data Science for Engineers	IITM	8 Weeks	September 22, 2024
4.		Programming in Java	IITKGP	12 Weeks	October 27, 2024
5.		Programming, Data Structures and Algorithms using Python	Chennai Mathematical Institute	8 Weeks	September 22, 2024
1.	Communication and Signal Processing	Analog Communication	IIT Kharagpur	12 Weeks	November 2, 2024
2.		Real-Time Digital Signal Processing	IISc Bangalore	12 Weeks	November 2, 2024
3.		C-Based VLSI Design	IIT Guwahati	12 Weeks	November 3, 2024
4.		Fiber Optic Communication Technology	IIT Madras	12 Weeks	October 11, 2024

ii) ***Minor Specialization (for students of other departments)***

Following courses are identified & proposed for their requirement towards getting Minor Speciation in Internet of Things:

Domain	Course Name	Offered By	Duration of course	Exam date
Internet of Things	Introduction To Internet Of Things	IITKGP	12 Weeks	November 2, 2024

	Introduction To Industry 4.0 And Industrial Internet Of Things	IITKGP	12 Weeks	October 26, 2024
	Analog Electronic Circuit	IIT Delhi	12 Weeks	November 2, 2024
	Microelectronics: Devices to Circuits	IIT Roorkee	12 Weeks	November 2, 2024

Item CIoT08	**To review and finalize the scheme structure of B.Tech. V Semester under the flexible curriculum (Batch admitted in 2022-23)** ➢ *The Scheme structure of V semester of the B.Tech Internet of Things of 2022-23 admitted batch under the flexible curriculum is at **ANNEXURE -7***
Item CIoT09	**To review and finalize the syllabi for all Departmental Core (DC) Courses of B. Tech. V Semester (for batch admitted in 2022-23) under the flexible curriculum along with their COs.** ➢ *The syllabus of B. Tech. V Semester of Internet of Things for the batch admitted in 2022-23 is prepared and is annexed at **ANNEXURE-08.***
Item CIoT10	**To review and recommend the Experiment list/ Lab manual for all the Laboratory Courses to be offered in B. Tech. V Semester (for batch admitted in 2022-23)** ➢ *The Experiment list/ Lab manual for various laboratory courses to be offered in along with the Course Outcomes of V semester of the B.Tech Internet of Things students of 2022-23 admitted batch under the flexible curriculum is included at **ANNEXURE-09***
Item CIoT11	**To review and recommend the list of projects which can be assigned under the "Skill based mini-project" category in various laboratory components based courses to be offered in B.Tech. V Semester (for the batch admitted in 2022-23).** ➢ *The list of skilled based mini projects for various laboratory courses to be offered in V semester of the B.Tech Internet of Things students of 2022-23 admitted batch under the flexible curriculum is included at **ANNEXURE-10***

Item CIoT12	**To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered (for batch admitted in 2022-23) in online mode under Self-Learning/ Presentation, in the B.Tech. V Semester.** ➢ *The List of Self Study and Seminar of B. Tech. V Semester of Internet of Things for the batch admitted in 2021-22 is prepared and is annexed at* ***ANNEXURE-11***
Item CIoT13	**To review and finalize the scheme structure of B.Tech. III Semester under the flexible curriculum (Batch admitted in 2023-24)** ➢ *The Scheme structure of III semester of the B.Tech Internet of Things of 2023-24 admitted batch under the flexible curriculum is at* ***ANNEXURE -12***
Item CIoT14	**To review and finalize the syllabi for all Departmental Core (DC) Courses of B. Tech. III Semester (for batch admitted in 2023-24) under the flexible curriculum along with their COs.** ➢ *The syllabus of B. Tech. III Semester of Internet of Things for the batch admitted in 2023-24 is prepared and is annexed at* ***ANNEXURE-13***
Item CIoT15	**To review and recommend the list of experiments and skill-based mini projects of B.Tech. III semester (for batch admitted in 2023-24)** ➢ *The Experiment list/ Lab manual for various laboratory courses to be offered in along with the Course Outcomes of III semester of the B.Tech Internet of Things students of 2023-24 admitted batch under the flexible curriculum is included at* ***ANNEXURE-14***
Item CIoT16	**To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered in the B.Tech. III Semester (for batches admitted in 2023-24) in online mode under Self-Learning/ Presentation.** ➢ *The List of Self Study and Seminar of B. Tech. V Semester of Internet of Things for the batch admitted in 2021-22 is prepared and is annexed at* ***ANNEXURE-15***
Item CIoT17	**To discuss and recommend the scheme structure & syllabi of PG Programme (M.E./M.Tech./MCA/MBA) along with their Course Outcomes (COs)** ***Not Applicable***
Item CIoT18	**To recommend the scheme structure and Syllabus of Ph.D. Course Work (specific to Doctoral Research Scholars, if any)**

	Not Applicable
Item CIoT19	**To review the CO attainments, to identify gaps and to suggest corrective measures for the improvement in the CO attainment levels for all the courses taught during July-Dec 2023 session.** ➢ *ANNEXURE -16*
Item CIoT20	**To review the PO attainments levels and suggest the actions to be taken for improvement in PO attainment.** ➢ *ANNEXURE -16*
Item CIoT21	**To review and finalize the CO-PO mapping matrix for all the courses to be taught in July-Dec 2024.** ➢ *ANNEXURE -16*
Item CIoT22	**To review curricula feedback from various stakeholders, its analysis and impact.** ➢ *ANNEXURE -17*
Item CIoT23	**Any other matter** **NA**

Suggestion by Expert Members:

1. Assignments based on Realistic Problem solving will be given
2. MOOCs offered courses will be mentored
3. Labs on Wireless Embedded System will be introduced
4. Courses offered on Applications of IoT for Power Electronics will be offered
5. Students will be motivated to participated in the online coding competitions for enhancing the programming skills

The meetings ended with the vote of thanks by BoS Coordinator.

Dr. Gaurav Khare | Dr. Murli Manohar | Dr. Kaushal Pratap Sengar | Dr. Bhavna Rathore

Dr. Saurabh Kumar Rajput | Dr. Yashwant Sawle | Dr. Nookala Venu | Dr. Priyanka Garg

Dr. Aditya Dubey | Dr. Dhananjay Bisen

Absent
Dr. Narendra Kumar -1
Professor, Department of Electrical Engineering, DTU-Delhi

Present
Dr. Anmol Ratna Saxena
Associate Professor, NIT-Delhi

Present
Dr. Prakash Chittora
Assistant Professor, DTU

Present
Mr. Paurush Godhar
Manager, Strategy & Consulting-Accenture

Present
Er. Shubham Sharma
Engineers Control, General Electric
Bangluru

31/05/24
Dr. Praveen Bansal
Assistant Professor
Coordinator, Centre for Internet of Thing

EE10T

(8)

माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर (म.प्र.), भारत
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Centre for Internet of Things

Scheme of Evaluation

B.Tech. III Semester (Internet of Things)

(for batch admitted in academic session 2023-24)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	Mode of Exam
				Theory Slot				Practical Slot									
				End Term Evaluation		Continuous Evaluation		End Sem. Exam	Continuous Evaluation			L	T	P			
				End Sem. Exam	$Proficiency in subject /course	Mid Sem. Exam.	Quiz/Assignment		Lab Work & Sessional	Skill Based Mini Project							
1.	3220301	DC	Database Management System	50	10	20	20	40	30	30	200	2	1	2	4	Offline	PP
2.	3220302	DC	Fundamentals of Signals and Control Systems	50	10	20	20	-	-	-	100	2	1	-	3	Offline	PP
3.	3220303	DC	Design & Analysis of Algorithms	50	10	20	20	40	30	30	200	2	1	2	4	Offline	PP
4.	3220304	DC	Computer Networks & Protocols	50	10	20	20	-	-	-	100	2	1	-	3	Offline	PP
5.	3220305	DC	Electronic Systems Thinking & Circuits	50	10	20	20	40	30	30	200	2	1	2	4	Offline	PP
6.	3220306	DLC	Self-learning/ Presentation (SWAYAM/NPTEL/MOOC)#	-	-	-	-	-	40	-	40	-	-	2	1	Online+ Mentoring	SO
7.	200xxx	CLC	Novel Engaging Course (Informal Learning)	-	-	-	-	50	-	-	50	-	-	2	1	Interactive	SO
8.	3220307	DLC	Skill Internship Program (Institute Level Evaluation)	-	-	-	-	60	-	-	60	-	-	4	2	offline	SO
Total				250	50	100	100	230	130	90	950	10	5	14	22	-	-
9.	3000002	Natural Sciences & Skills	Engineering Chemistry	50	10	20	20	30	10	10	150	1	-	2	GRADE	Blended	MCQ
10.	1000001	MAC	Indian Constitution and Traditional Knowledge	50	10	20	20	-	-	-	100	2	-	-	Grade	Online	MCQ
Summer Internship Project – I (Institute Level) (Qualifier): Minimum two-week duration: Evaluation in III Semester.																	

$Proficiency in course/subject – includes the weightage towards ability/ skill/ competency /knowledge level /expertise attained etc. in that particular course/subject

Natural Sciences& Skills: Engineering Physics / Engineering Chemistry / Environmental Science/ Language

Credits of Natural Sciences & Skills will be added in the VI Semester.

MCQ: Multiple Choice Question **AO:** Assignment + Oral **OB:** Open Book **PP:** Pen Paper **SO:** Submission + Oral

16/07/24

Dean 16/7/24
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Centre for Internet of Things

For batch admitted in academic session 2022 – 2023

Scheme of Evaluation

B.Tech. V Semester (Internet of Things)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching (Online ,Offline, Blended)	$\$\$$Mode of Exam.
				Theory Slot				Practical Slot									
				End Term Evaluation		Continuous Evaluation		End Sem. Exam	Continuous Evaluation			L	T	P			
				End Sem. Exam	$\$$Proficiency in subject /course	Mid Sem. Exam	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project							
1.	2220501	DC	Advanced Engineering Measurements	50	10	20	20	-	-	-	100	2	1	-	3	Offline	PP
2.	2220502	DC	Cloud Computing	50	10	20	20	-	-	-	100	3	-	-	3	Offline	PP
3.	2220503	DC	Wireless Technologies for IoT	50	10	20	20	60	20	20	200	3	-	2	4	Offline	PP
4.	2220504	DC	IoT Architecture and Protocols	50	10	20	20	60	20	20	200	2	1	2	4	Offline	PP
5.	2220505	MC	Data Sciences in IoT	50	10	20	20	60	20	20	200	3	-	2	4	Offline	MCQ
6.	2220506	DLC	Minor Project-I**	-	-	-	-	60	40	-	100	-	-	4	2	Offline	SO
7.	2220507	DLC	Self-learning/Presentation (SWAYAM/NPTEL/ MOOC)#	-	-	-	-	-	40	-	40	-	-	2	1	Online + Mentoring	SO
8.	200xxx	CLC	Novel Engaging Course (Informal Learning)	-	-	-	-	50	-	-	50	-	-	2	1	Interactive	SO
9.	2220508	DLC	Summer Internship Project–II (Institute Level Evaluation)	-	-	-	-	60	-	-	60	-	-	4	2	Offline	SO
Total				250	50	100	100	350	140	60	1050	13	2	18	24		
10.	1000006	MAC	Disaster Management	50	10	20	20	-	-	-	100	2	-	-	Grade	Online	MCQ
Additional Course for Honours or Minor Specialization				Permitted to opt for maximum two additional courses for the award of Honours or Minor specialization													

$\$$proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.
$\$\$$MCQ: Multiple Choice Question $\$\$$AO: Assignment + Oral $\$\$$PP: Pen Paper $\$\$$SO: Submission + Oral
Minor Project-I may be evaluated by an internal committee for awarding sessional marks.
#Compulsory registration for one online course using SWAYAM/NPTEL/MOOC, evaluation through attendance, assignments and presentation
Note: Students of 2020-21 admitted batch needs to appear and complete an additional MAC course of 30 Hrs. duration on Project Management & Financing, 7 other modules related to futuristic technologies (Drones/ Robotics etc.)

Mode of Teaching						Mode of Examination					Total Credits
Theory				Lab	NEC	Theory			Lab	SIP/ SLP/ NEC	
ffline	Online	Blended		Offline	Interactive	PP	A+O	MCQ	SO	SO	
		Offline	Online								
-	-	10	5	8	1	12	-	3	5	4	24
9.1 %	13.6 %	41.7%	20.8 %	33.33 %	4.16%	50 %	-	12.5 %	20.8 %	16.7 %	Credits %

16/7/24

Dean
Faculty of Engineering & Technology
MITS-DU

16/7/24

Centre for Internet of Things

(i) Following courses are identified & proposed for **V Semester** for their requirement towards getting **Honors (Admitted Batch 2022-23)**

S. No	Tracks	Course Name	Offered By	Duration of Course	Start Date	End Date	Exam Date
	Artificial Intelligence and Machine Learning	Introduction to Machine Learning	IITM	12 weeks	July 22, 2024	October 11, 2024	October 27, 2024
		Responsible & Safe AI Systems	IIT Madras	12 Weeks	11 Oct 2024	16 Aug 2024	02 Nov 2024
		Programming, Data Structures And Algorithms Using Python	CMI	8 weeks	July 22, 2024	September 13, 2024	September 22, 2024
		Artificial Intelligence : Search Methods For Problem solving	IIT Madras	12 Weeks	July 22, 2024	October 11, 2024	October 26, 2024
		Artificial Intelligence for Economics	IIT KGP	8 Weeks	July 22, 2024	September 13, 2024	September 22, 2024
	Smart Computing & Algorithms	Design and analysis of algorithms	CMI	8 weeks	July 22, 2024	September 13, 2024	September 22, 2024
		Programming, Data Structures And Algorithms Using Python	CMI	8 weeks	July 22, 2024	September 13, 2024	September 22, 2024
		The Joy of Computing using Python	IIT Ropar	12 Weeks	July 22, 2024	October 11, 2024	November 2, 2024
		Discrete Mathematics	IIT Ropar	12 Weeks	July 22, 2024	October 11, 2024	October 27, 2024
		Data Structure and Algorithms using Java	IIT KGP	12 Weeks	July 22, 2024	October 11, 2024	October 26, 2024
		Programming in Modern C++	IITKGP	12 Weeks	July 22, 2024	October 11, 2024	November 03, 2024
	Embedded System Design	Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software	IIT Delhi	12 Weeks	July 22, 2024	October 11, 2024	October 27, 2024
		Microelectronics: Devices to Circuits	IIT Roorkee	12 Weeks	July 22, 2024	October 11, 2024	October 27, 2024
		Real-Time Digital Signal Processing	IISc Bangalore	12 Weeks	July 22, 2024	October 11, 2024	November 2, 2024

16/7/24

ii) ***Minor Specialization (for students of other departments)***

Following courses are identified & proposed for their requirement towards getting Minor Speciation in Internet of Things:

Domain	Course Name	Offered By	Duration of course	Exam date
Internet of Things	Introduction To Internet Of Things	IITKGP	12 Weeks	November 2, 2024
	Introduction To Industry 4.0 And Industrial Internet Of Things	IITKGP	12 Weeks	October 26, 2024
	Analog Electronic Circuit	IIT Delhi	12 Weeks	November 2, 2024
	Microelectronics: Devices to Circuits	IIT Roorkee	12 Weeks	November 2, 2024

16/7/24

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For batch admitted in academic session 2021 – 2022

Scheme of Evaluation

B. Tech. VII Semester (Internet of Things)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted									Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	^{SS}Mode of Exam.
				Theory Slot				Practical Slot			MOOCs								
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation		Assignment	Exam		L	T	P			
				End Sem. Exam.	$^{\$}$Proficiency in subject	Mid Sem. Exam	Quiz/ Assignment		Lab work &Sessional	Skill Based Mini Project									
1.	220701/ 220702	DE	Departmental Elective** (DE2)	50	10	20	20	-	-	-	-	-	100	3	-	-	3	Offline	PP
2.	220757/ 220758/ 220759/ 220760	DE	Departmental Elective* (DE-3) - MOOC	-	-	-	-	-	-	-	25	75	100	3	-	-	3	Online	MCQ
3.	220761/ 220762/ 220763	DE	Departmental Elective* (DE-4) - MOOC	-	-	-	-	-	-	-	25	75	100	3	-	-	3	Online	MCQ
4.	OC-2	OC	Open Category** (OC-2)	50	10	20	20	-	-	-	-	-	100	3	-	-	3	Offline	PP
5.	220703	DLC	Internet of Things Lab Advanced	-	-	-	-	60	40		-	-	100	-	-	4	2	Offline	SO
6.	220706	DLC	Creative Problem Solving	-	-	-	-	25	25	-	-	-	50	-	-	2	1	Offline	SO
7.	220705	DLC	Summer Internship Project-III (04 weeks) (Evaluation)	-	-	-	-	60	-	-	-	-	60	-	-	4	2	Offline	SO
Total				100	20	40	40	145	65	-	50	150	610	12	-	10	17	-	-
8	1000008	MAC	Universal Human Values &Professional Ethics(UHVPE)	50	10	20	20	-	-	-	-	-	100	2	-	-	GRADE	Online	MCQ
Additional Course for Honours or minor Specialization				Permitted to opt for maximum two additional courses for the award of Honors or Minor specialization															

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[S] Proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.
[SS]MCQ: Multiple Choice Question [SS]AO: Assignment + Oral [SS]PP: Pen Paper [SS]SO: Submission + Oral
* Course run through SWAYAM/NPTEL/ MOOC Learning Based Platform with Credit Transfer ** Course run in Traditional Mode

DE-3(SWAYAM/NPTEL/ MOOC platform)		DE-4 (SWAYAM/NPTEL/ MOOC platform)		**DE-2 (Traditional Mode)		OC-2 (Traditional Mode)	
Code	Course Name	Code	Course Name	Code	Course Name	Code	Course Name
220757	Pattern Recognition and Application (12 weeks)	220761	The Joy of Computing using Python (12 weeks)	220701	Smart Energy Analytics	910226	Smart Energy Analytics
220758	Getting Started with Competitive Programming (12 weeks)	220762	Deep Learning - IIT Ropar (12 weeks)	220702	Advanced IoT Applications	910203	IoT and its Applications
220759	Programming in Java (12 weeks)	220763	Smart Grid: Basics to Advanced Technologies (12 weeks)	–	---		
220760	Big Data Computing (8 weeks)						

(i) Following courses are identified & proposed for **VII Semester** for their requirement towards getting **Honors (Admitted Batch 2021)**

S. No	Tracks	Course Name	Offered By	Duration of Course	Exam Date
1.	Artificial Intelligence	Responsible & Safe AI Systems	IIT Madras	12 Weeks	November 2, 2024
2.		Introduction to Machine Learning	IITM	12 Weeks	October 27, 2024
3.		Artificial Intelligence : Search Methods For Problem solving	IIT Madras	12 Weeks	October 26, 2024
4.		Artificial Intelligence for Economics	IIT Kharagpur	8 Weeks	September 13, 2024

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1.	Computational Techniques	Data Structure and Algorithms using Java	IIT Kharagpur	12 Weeks	October 26, 2024
2.		Programming in Modern C++	IITKGP	12 Weeks	November 3, 2024
3.		Data Science for Engineers	IITM	8 Weeks	September 22, 2024
4.		Programming in Java	IITKGP	12 Weeks	October 27, 2024
5.		Programming, Data Structures and Algorithms using Python	Chennai Mathematical Institute	8 Weeks	September 22, 2024
1.	Communication and Signal Processing	Analog Communication	IIT Kharagpur	12 Weeks	November 2, 2024
2.		Real-Time Digital Signal Processing	IISc Bangalore	12 Weeks	November 2, 2024
3.		C-Based VLSI Design	IIT Guwahati	12 Weeks	November 3, 2024
4.		Fiber Optic Communication Technology	IIT Madras	12 Weeks	November 2, 2024

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Database Management System (3220301)

Course Objective:

- To understand the fundamental concepts of a database management system.
- To analyses database requirements and determine the entities involved in the system and their relationship to one another.
- To develop the logical design of the database using data modeling concepts & normalization.
- To manipulate a database using SQL commands.

Unit-I: Introduction: DBMS Concepts & Architecture, File processing system, limitation of file processing system, Advantages of Database System, Schemas, Instances, Data Independence, Data dictionary, Functions of DBA, Database languages, Data Models: Hierarchical Data Model, Network Data Model & Relational Data Model, E-R Model, Comparison between Models, Introduction of File organization Techniques.

Unit-II: Relational Data Models: Entities & Attributes, Entity types, Key Attributes, Relationships, Domains, Tuples, types of Attributes, Relations, Characteristics of Relations, Keys, Attributes of Relation, Relational Database, Integrity Constraints. Relational Algebra: Concept and Relational Algebra operations like Select, Project, Join, Division, Union etc.

Unit-III: SQL: Introduction of SQL, features of SQL, Data Definition & Data Manipulation commands in SQL, SQL operators, Update Statements & Views in SQL, Query & Sub query, Data Retrieval Queries & Data Manipulation Statements examples etc. Overview of Tuple Oriented Calculus & Domain Oriented Relational Calculus.

Unit-IV: Normalization: Introduction to Normalization, concepts of anomalies and its types, closure set of dependencies and of attributes, Various Normal Forms: 1NF, 2NF, 3NF, BCNF, Functional Dependency, Decomposition, Dependency Preservation, Loss Less & Lossy Join, Definition of Dangling Tuple, and Multi-values Dependencies.

Unit-V: Transaction Processing & Concurrency Control: Transaction Processing Concepts, ACID properties, State Diagram, Types of Transaction, Basic idea of serializability, Concurrency Control, Concurrent operation of Databases, Recovery, Types of Recovery, Basic overview of Distributed Databases System and Relational Database Management System, Concepts of Object-Oriented Database System and its tools.

Recommended Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill, 6th Edition.
2. Raghu Rama krishnan, Johannes Gehrke,"Database Management System", McGraw Hill., 3rd Edition.
3. Elmasri & Navathe, "Fundamentals of Database System", Addison-Wesley Publishing, 5th Edition.
4. Date C.J, "An Introduction to Database", Addison-Wesley Pub Co, 8th Edition.
5. B.C. Desai, "An introduction to Database systems".

Course Outcomes

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

CO1: **Explain** different types of database systems and their characteristics.
CO2: **Compare** different issues involved in the design and implementation of database systems.
CO3: **Illustrate** principles for logical design of databases, including the E-R modeling and Normalization approach.
CO4: **Apply** transaction processing concepts and recovery methods over real time data.
CO5: **Formulate** using relational algebra and SQL, solutions to a broad range of query problems.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	1	1	1	1	2	3	-	-
CO2	3	3	3	2	1	3	1	1	1	1	2	3	-	-
CO3	3	3	3	2	2	2	1	1	1	1	2	3	-	-
CO4	3	3	3	3	3	1	1	1	1	1	3	3	-	-
CO5	3	2	3	3	3	2	1	1	1	1	3	3	-	-

1 - Slightly; 2 - Moderately; 3 – Substantially

Fundamentals of Signals and Control Systems: 3220302

Course Objectives:

- To develop an understanding of fundamental characteristics of signals and systems.
- To develop mathematical skills to solve problems involving convolution, and sampling.
- To understand the concepts of various transforms for signal analysis.
- To learn the basics of system representations, control systems and dynamic system response.

Unit I: Elementary Signals & Systems:

Basic definitions and classification of signals, impulse, step, complex exponential and sinusoidal signals, system models and basic properties, representation of signals and systems, Linear Time Invariant (LTI) systems: convolution sum, convolution integral, properties, difference equations, differential equations, and eigen functions.

Unit II: Fourier Transforms

Fourier series representation of periodic signals, properties of Fourier series, LTI system response to periodic signals, spectral properties of signals, continuous-time Fourier transform: properties, convolution property.

Unit III: Sampling and Discrete Transforms

Sampling Theorem, sampling of continuous time signals and signal reconstruction, sampling of discrete time signals. Discrete-time Fourier transform: properties, convolution property. Z-Transform: definition, region of convergence and properties, inverse z-transform, LTI systems analysis using the z-transform.

Unit IV: System Representations and basics of Control System

Laplace Transform: definition, region of convergence, and properties, representation of LTI systems using the Laplace transform. Fundamentals of control: plant, input, output, open loop system, closed loop system and need for modeling, Transfer functions, significance of poles & zeros, stability: definition, equilibrium state, and bounded input bounded output stability. state representation: concepts of state, sate variables and state space model.

Unit V: Dynamic Response of Systems

Response of LTI systems to excitation, solutions of state equations. Transition matrix of an LTI system, Transformation from transfer function model to State-Space representation, Eigenvalues and their role to the state evolution matrix, Concepts of Controllability and Observability, transformation between time and frequency domain, basic concepts of bode plot.

Recommended Books:

1. Signal and systems by Oppenheim AV, Willisky AS and Nawab SH, Pearson
2. Signals and systems by Hwel. P. Hsu, Schaum's outlines, TME
3. Digital Signal Processing Principles by Proakis JP, Manolaxis, Pearson
4. Fundamentals of Signals & Systems by Michael J Roberts, McGraw Hill
5. Control System Engineering by I.J. Nagrath and M. Gopal, New Age International Publication.
6. Control System Engineering by Norman Wiley Publication.
7. Linear Control Systems by B. S. Manke, Khanna Publishers
8. Modern Control Systems by R. C. Dorf and R. H. Bishop, Addison-Wesley publishing company.

Course Outcomes

After the completion of this course students will be able to:

- **CO 1.** **Describe** the elementary characteristics of the signals and systems.
- **CO 2.** **Analyze** the spectral characteristics of periodic signals using Fourier Transforms.
- **CO 3.** **Explain** the sampling process and discrete transforms for the analysis of discrete time-signals and systems.
- **CO 4.** **Apply** the Laplace transform for the analysis of continuous-time signals and systems.
- **CO 5.** **Describe** the concepts of control system and system representation using transfer function and state variables.
- **CO 6.** **Apply** the time domain and frequency domain behavior of the dynamic response of systems.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3	1	1	1	1	1	1	3	-	-
CO2	3	2	2	3	2	1	1	1	1	1	1	3	-	-
CO3	3	2	3	3	2	2	1	1	1	1	1	3	-	-
CO4	3	2	2	3	3	1	1	1	1	1	1	3	-	-
CO5	3	2	3	3	2	1	1	1	1	1	1	3	-	-
CO6	3	3	3	3	2	1	1	1	1	1	1	3	-	-

1 - Slightly; 2 - Moderately; 3 - Substantially

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DesignandAnalysisofAlgorithms: 3220303

COURSEOBJECTIVES

- Tointroducethetopicofalgorithmsasaprecisemathematicalconcept.
- To study the techniques like recursion, divide and conquer, dynamic programming, greedyapproach,backtrackingandbranch andbound.
- Topracticetheirskillsonmanywell-knownalgorithmsanddatastructuresdesignedtosolvereal-life problems.

Unit-I

Introduction to Computational Model: Algorithms and its Importance, Recurrences andAsymptotic Notations, Mathematical Analysis of Non-Recursive and Recursive Algorithm,Review of Sorting & Searching Algorithms, Basic Tree and Graph Concepts: B-Trees andTraversalTechniques, Topologicalsort.

Unit-II

Divide and Conquer Method: Introduction and its Examples such as Finding the Maximumand Minimum, Binary Search, Merge Sort, Quick Sort and Strassen's Matrix MultiplicationandAdditionalRealWorldProblemson DivideandConquer.

Unit-III

GreedyMethod:Introduction,Characteristics,ExamplesofGreedyMethodssuchasSingle-SourceShortestPaths,MinimumCostSpanningTrees:Prims'sandKruskal'sAlgorithm, Knapsack Problem, Dijkstra's Single Source Shortest Path Algorithm,OptimalStorageon Tapes.

Unit-IV

Dynamic Programming: Introduction, The Principle of Optimality, Examples of DynamicProgramming Methods such as – 0/1 Knapsack, Traveling salesman problem, Floyd's AllPairs Shortest Path, Longest Common Subsequence and Reliability Design, Matrix ChainMultiplication

Unit-V

Backtracking:ConceptanditsExampleslike4-Queen'sProblem,KnapsackproblemHamiltonianCircuitProblem,GraphColoringProblemetc.Branch&Bound:IntroductionanditsExampleslike-TravelingSalespersonProblemetc.NP-Completeness:Introduction,ClassPandNP,PolynomialReduction,NP-Hard andNP-CompleteProblems.

CourseOutcomes

Aftercompletionofthiscourse,thestudentswouldbeableto:

CO1. **Define**thebasicfeaturesofAlgorithms.
CO2. **Describe** major Algorithms and Data Structures.CO3. **Apply**variousalgorithmicdesignparadigms.
CO4. **Analyze**theasymptoticperformanceofAlgorithms.
CO5. **Compare**differentdesigntechniquestodevelopalgorithmsforcomputationalproblems.
CO6. **Design**algorithmsusinggreedystrategy,divideandconquerapproach,dynamicprogramming,backtracking, branchandbound approach.

ReferenceBooks/TextBooks:

1. FundamentalsofComputerAlgorithms,Horowitz&Sahani,Universitiespress.
2. IntroductiontoAlgorithms,CoremenThomas,LeisersonCE,RivestRL,PHI.
3. Design&AnalysisofComputerAlgorithms,Ullmann,Pearson.
4. AlgorithmDesign,MichaelTGoodrich,RobartoTamassia,WileyIndia.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	1	1	1	1	1	3	-	-
CO2	3	3	3	3	2	1	1	1	1	1	1	3	-	-
CO3	3	3	3	3	2	2	1	1	1	1	1	3	-	-
CO4	3	3	2	3	3	1	2	1	1	1	1	3	-	-
CO5	3	2	2	3	2	1	1	1	1	1	1	3	-	-
CO6	3	2	3	3	3	1	1	1	1	1	1	3	-	-

1 - Slightly; 2 - Moderately; 3 – Substantially

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Computer Networks & Protocols (3220304)

Course Objectives:

- Familiarize the student with the basic taxonomy and terminology of the computer networking & Protocols.
- Provide detailed knowledge about various layers, protocols and devices that facilitate networking.
- Enable students to deal with various networking problems such as flow control, error control and congestion control.

Unit 1: Introduction – Computer Network Types, OSI Reference Model & TCP/IP Reference Model, Circuit Switching, Message Switching & Packet Switching, Frequency Division Multiplexing, Wavelength Division Multiplexing & Time Division Multiplexing, ISDN, SONET.

Physical Layer: Data Transmission Modes, Network topologies, Line Coding, Synchronous & Asynchronous Transmission, Transmission Medium - Guided & Unguided, Networking Devices, Performance Criteria.

Unit 2: Data Link Layer – Introduction, Design Issues, Services, Framing, Error Control, Flow Control, ARQ Strategies, Error Detection and Correction, Parity Bits, Cyclic Redundant Code (CRC), Hamming Codes, MAC Sublayer - Channel Allocation Problem, Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, IEEE 802.3, IEEE 802.4 and IEEE 802.5, HDLC.

Unit 3: Network Layer – Introduction, Design Issues, Services, Routing- Distance Vector Routing, Hierarchical Routing & Link State Routing, Shortest Path Algorithm- Dijkstra's Algorithm & Floyd–Warshall's Algorithm, Routing Protocols, Flooding, Connection Oriented & Connectionless Service, IP Addressing, IPV4, IPV6, Internet Protocol Datagram, Fragmentation, ICMP, IGMP.

Unit 4: Transport Layer – Datagram Protocol (UDP) - Process To Process Communication, Port Number, Socket Address, User Datagram, UDP Operation. TCP Services, Process To Process Communication, Stream Delivery Service, Full Duplex Communication, Connection Oriented Service, Reliable Service, TCP Features- Numbering System, Flow Control, Error Control, Congestion Control , TCP Segment, Flow Control- Sliding Window Protocol, Silly Window Syndrome Error Control- Checksum, Acknowledgement, Retransmission, Congestion Control.

Unit 5: Application Layer – Introduction, Design Issues, Presentation Layer - Translation, Encryption - Substitutions and Transposition Ciphers, Compression - Lossy and Lossless. Session Layer - Dialog Control, Synchronization. Application Layer - Remote Login, File Transfer & Electronic Mail. Domain Name System (DNS), Telnet, FTP, TFTP, Email Protocol: SMTP, POP, IMAP.

Reference Books/ Text Books:

1. Data Communication and Networking, Behrouz A. Forouzan, McGraw Hill.
2. Computer Networks, Andrew S. Tanenbaum, Pearson Education India.
3. Computer Networks and Internets, Douglas E. Comer, Pearson India.
4. TCP/IP Protocol Suite, B. A. Fourozan, Tata McGraw Hill
5. Internetworking with TCP/IP, Douglas E. Comer, Publisher- PHI, New Delhi
6. TCP/IP Illustrated by Richard Stevens, Publisher- Addison – Wesley.

Course Outcomes:

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

CO1. Explain the fundamental concepts of computer network.

CO2. Illustrate the basic taxonomy & terminologies of computer network protocols.

CO3. Explain IP addressing and routing mechanism.

CO5. Apply the concept of computer network in congestion and internet.

CO6. Design the network environment for implementation of computer networking concept.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2	1	1	1	1	1	2	3	-	-
CO2	3	2	1	2	3	1	1	1	1	1	2	3	-	-
CO3	3	3	3	3	3	1	1	1	1	1	2	3	-	-
CO4	3	2	2	1	3	1	1	1	1	1	3	3	-	-
CO5	3	3	3	3	3	2	1	1	1	1	3	3	-	-
CO6	3	3	3	3	3	3	1	1	1	1	3	3	-	-

1 - Slightly; 2 - Moderately; 3 – Substantially

Electronic Systems Thinking & Circuits : 3220305

Course Objective: The course aims to equip students with a deep understanding of semiconductor devices and circuits, including diodes, transistors, operational amplifiers, and power systems. Through theoretical learning and practical exercises, students will develop analytical and practical skills to design, analyze, and troubleshoot electronic circuits, fostering critical thinking and innovation.

Unit-1: PN JUNCTION DIODE and its application:

Semiconductor materials- intrinsic and extrinsic types, Ideal Diode, Terminal characteristics of diodes: p-n junction under open circuit condition p-n junction under forward bias and reverse bias conditions p-n junction in breakdown region, Diode small signal model , Zener diode and applications , Clipping and Clamping circuits

UNIT-2: RECTIFIERS AND FILTERS:

PN junction as a rectifier, half wave rectifier, Center-Tapped full wave rectifier, Bridge full wave Rectifier, Harmonic components in a rectifier circuit, Capacitor filter and Inductor filter.

UNIT-3: Bipolar junction transistors (BJT):

Physical structure and operation modes , Active region operation of transistor , D.C. analysis of transistor circuits , Transistor as an amplifier , Biasing the BJT: fixed bias, emitter feedback bias, collector feedback bias and voltage divider bias , Basic BJT amplifier configuration: common emitter, common base and common collector amplifiers, Transistor as a switch: cut-off and saturation modes ,Transistor as a rectifier

UNIT-4: Operation Amplifier (Op-Amps):

Ideal Op-amp, Differential amplifier: differential and common mode operation common mode rejection ratio (CMRR), Practical op-amp circuits: inverting amplifier, non -inverting amplifier, weighted summer, integrator, differentiator, large signal operation of op-amps, other applications of op-amps: instrumentation circuits, active filters, controlled sources, logarithmic amplifiers, waveform generators, Schmitt triggers, comparators

UNIT-5: Power circuits and systems:

Regulated power supply, Shunt voltage regulator, and Transistorized series voltage regulator (basic and with feedback, without derivation), Three Terminal Fixed/variable voltage regulator: 78xx, 79xx, LM317 etc, Switch mode power supply(SMPS) Uninterruptible power supply(UPS).

Course Outcomes:

- **CO 1:** **Demonstrate** a comprehensive understanding of semiconductor materials, diode and transistor operation
- **CO 2:** **Analyze** terminal characteristics of diodes, transistor operation modes, and operational amplifier circuits to solve complex electronic problems.
- **CO 3:** **Apply** theoretical knowledge to design and implement various electronic circuits including rectifiers, filters, amplifiers, and power supply systems.
- **CO 4:** **Develop** the ability to troubleshoot and rectify issues in electronic circuits through systematic analysis and testing.
- **CO 5:** **Evaluate** the innovative solutions for improving circuit performance, efficiency, and reliability in real-world applications.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	1	1	1	1	1	1	3	2	-
CO2	3	3	3	3	2	1	1	1	1	1	1	3	2	-
CO3	3	3	3	3	2	1	1	1	1	1	1	3	2	-
CO4	3	3	2	3	3	1	1	1	1	1	1	3	3	-
CO5	3	2	2	3	3	1	1	1	1	1	1	3	3	-

1 - Slightly; 2 - Moderately; 3 – Substantially

Advanced Engineering Measurements: 2220501

Course Objectives:

This course aims to equip students with the skills to understand, design, and analyze measurement systems for electrical and mechanical parameters, ensuring precision and accuracy. Students will master various measurement techniques and tools, including statistical analysis and error propagation.

UNIT - I: Fundamentals of Measurements:

Introduction, types of measurements, generalized measurement system with examples, static & dynamic characteristics of measurement system, types of Errors, error sources and remedies, statistical analysis of data, regression analysis (using excel) of data, distortion. Systematic and random errors in measurement, expression of uncertainty - accuracy and precision, propagation of errors, linear and weighted regression.

UNIT - II: Electrical measurements (Part-1):

Fundamentals: Basic parameters like Current, Voltage, RMS value, Average value, Power, Power factor, Resistance, Impedance, Inductance, and Capacitance. Measurements using: PMMC, Extension of range, Moving Iron, Electro dynamo meter, Thermocouple type, Energy Meters

UNIT - III: Electrical measurements (Part-2):

Measurement of voltage, current and power in single and three phase circuits; ac and dc current probes; instrument transformers, digital voltmeter, digital multimeter. Bridges: Bridges: Wheatstone, Kelvin, Megohm, Maxwell, Anderson, Schering and Wien for measurement of R, L, C and frequency.

UNIT - IV: Electronic measurements:

Fundamentals of Cathode Ray Oscilloscope: Block diagram, CRO probes, Delay line, types of Oscilloscopes. Measurement of Signal voltage, Current, Phase & Frequency using Lissajous patterns, Industrial applications of CRO. Electro-physiological measurements: Electrodes, ECG – EEG – EMG – ERG typical waveforms.

UNIT - V: Mechanical measurements:
Fundamentals: Displacement, Velocity, Speed, Force, Moment, Torque, Stress, Strain, Pressure, Flow, Temperature, Viscosity, Humidity.
Measurement of Displacement – Flapper-Nozzle technique, LVDT, Interferometer.
Distance, Speed, Force/Torque and Temperature Measurement.

Recommended Books:

1. Experimental methods for engineers – JP Holman – 7e – TMH
2. Mechanical measurements – Thomas G Beckwith – 6e – Pearson
3. Introduction to Instrumentation and Measurements – Robert B Northrop – 2e – CRC Press
4. Measurements and Instrumentation principles – Alan S Morris
5. Hand Book of Bio-Medical instrumentation – R.S. Khandpur, TMH
6. A course in electrical & electronic measurements and instrumentation – AK Sawhney

Course Outcomes

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

CO1: **Explain** the types and characteristics of measurement systems, identify sources of errors, and apply remedies for accurate measurements.
CO2: **Describe** statistical and regression analysis of measurement data, and express uncertainty with accuracy and precision.
CO3: **Describe** basic electrical parameters such as current, voltage, power, resistance, and capacitance using various instruments.
CO4: **Apply** Cathode Ray Oscilloscopes (CRO) and other electronic tools to measure signal voltage, current, phase, and frequency.
CO5: **Apply** mechanical parameters like displacement, velocity, force, pressure, and temperature using appropriate techniques and tools.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	3	1	2	1	1	2	2	-	-
CO2	3	3	3	3	3	3	1	2	1	1	1	3	-	-
CO3	3	3	2	2	2	2	1	1	1	1	1	2	-	-
CO4	3	3	3	3	3	2	1	1	1	1	1	3	-	-
CO5	3	3	3	3	3	2	1	1	1	1	2	3	-	-

1 - Slightly; 2 - Moderately; 3 – Substantially

Cloud Computing: 2220502

Course Objectives:

- Understand the concepts, technologies, architecture, and applications of cloud computing and learn the underlying principles of cloud virtualization, cloud storage, data management, and data visualization.
- Explore different cloud programming platforms and tools for developing and deploying applications on the cloud.
- Understand significant considerations for choosing a cloud platform and gain knowledge of AWS IoT Core, Microsoft Azure – IoT, and Google Cloud IoT Core.

Unit I - Cloud Architecture and Model:

Technologies for Network-Based System, System Models for Distributed and Cloud Computing, NIST Cloud Computing Reference Architecture. Cloud Models: - Characteristics, Cloud Services, Cloud models (IaaS, PaaS, SaaS), Public vs Private Cloud, Cloud Solutions Cloud ecosystem, Service management, Computing on demand.

Unit II – Virtualization:

Basics of Virtualization, Types of Virtualizations, Implementation Levels of Virtualization, Virtualization Structures, Tools and Mechanisms, Virtualization of CPU, Memory, I/O Devices. Virtual Clusters and Resource management, Virtualization for Data-center Automation.

Unit III- Cloud Infrastructure:

Layered Cloud Architecture Development, Design Challenges, Inter Cloud Resource Management, Resource Provisioning and Platform Deployment, Global Exchange of Cloud Resources. Introduction to IoT Platform, Cloud IoT Architecture, IoT Cloud Services.

Unit IV- Programming Model:

Parallel and Distributed Programming Paradigms- MapReduce, Twister and Iterative MapReduce, Hadoop Library from Apache, Google App Engine (GAE), Amazon Web Service (AWS) and Microsoft Azure IoT Core Services, Business & Technical Considerations for Choosing the Right IoT Cloud Platform

Unit V - Security in the Cloud:

Security Overview, Cloud Security Challenges and Risks, Software-as-a-Service Security, Security Governance, Risk Management, Security Monitoring, Security Architecture Design, Data Security, Application Security, Virtual Machine Security, Identity Management and Access Control.

Recommended Books:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. John W. Rittinghouse and James F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009.
4. Kumar Saurabh, "Cloud Computing—insights into New-Era Infrastructure", WileyIndia, 2011
5. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O'Reilly
6. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.

Course Outcomes

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

CO 1. Describe various basic concepts related to cloud computing.
CO 2. Explain the architecture, infrastructure, and delivery models of cloud computing.
CO 3. Choose the appropriate programming models and public cloud platforms.
CO 4 . Analyze various security issues in cloud computing.
CO 5. Compose virtualization, security, and programming modules in cloud computing solutions.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	1	1	1	1	2	1	3		
CO2	3	2	3	2	3	1	2	1	1	2	1	3		
CO3	2	2	3	2	3	1	1	1	1	2	1	3		
CO4	2	3	2	3	2	2	1	3	1	2	1	3		
CO5	3	3	3	3	3	2	2	2	1	3	2	3		

1 - Slightly; 2 - Moderately; 3 – Substantially

Wireless Technologies for IoT: 2220503

Course Objectives:

This course focused into the realm of wireless technologies in the Internet of Things (IoT), focusing on hands-on applications using Arduino, NodeMCU, and ESP32. Through practical experiments and theoretical discussions, students will gain a comprehensive understanding of various wireless communication protocols and their integration into IoT systems.

Unit 1: Introduction:

Introduction to various Arduino platforms, NodeMCU, and ESP32, covering hardware specifications, programming environments, and basic interfacing techniques and its application in industry

Unit 2: Wi-Fi Technologies

Introduction on Wi-Fi communication, various Wi-Fi modules, particularly ESP8266 and ESP32, Wi-Fi networks for data transmission and its significance in IoT applications.

Unit 3: Bluetooth and Zigbee Technologies

Introduction to Bluetooth and ZigbeeTechnologies,Bluetooth Low Energy (BLE) and Zigbee Protocol and interfacing devices,concepts of different Bluetooth modules like HC-05 and HM-10, as well as Zigbee modules such as Xbee, Security and Optimization in Bluetooth and Zigbee Networks, exchanging data, and setting up Zigbee networks and integrating these technologies into IoT projects.

Unit 4: Long-Range and Low-Power Wireless Technologies

Introduction to LPWAN Technologies, Principles of LoRaModulation,LoRaWAN Architecture, LoRaWAN Network Deployment ,LoRaWAN Protocol Stack, Security and Performance Optimization and Emerging Trends and Future Directions

Unit 5: Cellular and Satellite Connectivity:

Introduction to Cellular and Satellite Communication Technologies for IoT,Integration and Deployment of Cellular and Satellite Connectivity using GSM/GPRS modules like SIM800 , SIM900, LTE modules, and satellite communication modules,interfacing with microcontroller and use cases in applications such as connected vehicles, remote monitoring, and global tracking. **Recommended Textbooks:**

1. Arduino Programming in 24 Hours, Sams Teach Yourself by Richard Blum and Tim McGrath
2. Getting Started with ESP8266: Programming the Internet of Things with Lua and Arduino by Simon Monk
3. Bluetooth Low Energy: The Developer's Handbook by Robin Heydon
4. Zigbee Wireless Networking by Drew Gislason
5. LoRa for the Internet of Things by Agamemnon T. Filippou and George Mastorakis
6. Cellular Internet of Things: Technologies, Standards, and Performance by OlofLiberg, Marten Sundberg, and Eric Wanglund

Course Outcomes:

CO1: **Gain** knowledge of Arduino platforms, NodeMCU, and ESP32, including hardware specifications.

CO2: **Explain** Wi-Fi communication principles, Wi-Fi modules (especially ESP8266 and ESP32), and their significance in IoT applications.

CO3: **Describe** Bluetooth Low Energy (BLE) and Zigbee protocols, along with practical skills.

CO4: **Apply** LPWAN technologies, LoRa modulation principles and itsLoRaWAN architecture.

CO5: **Apply** skills in integrating and deploying cellular (e.g., GSM, LTE) and satellite connectivity for IoT applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	3		3	3	1	3	2	3	
CO2	2	3	3	3	3	1		3	2		2	2	3	
CO3	3	3	1	2	3	1		3	3		3	3	3	
CO4	2	3	1	1	3	2	2	3	2	2	3	3	2	
CO5	3	3	2	3	3	2	1	3	3	2	3	3	3	

Centre for Internet of Things

IoT Architecture and Protocols: 2220504

Course Objective:

The main objective of the course is to teach students the fundamental concepts and architecture of the Internet of Things, as well as the various protocols that are utilized in IoT applications.

Unit I – Introduction: IoT architecture outline, standards - IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics

Unit II – IoT reference architecture: Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints

Unit III – IoT data link layer & network layer protocols: PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, ZWave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP

Unit IV – IoT transport & session layer protocols: Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT

Unit V – IoT service layer protocols & security protocols: Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC802.15.4, 6LoWPAN, RPL, Application Layer.

Course Outcomes:

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

CO 1. **Explain** various concepts, terminologies, and architecture of IoT systems
CO 2. **Describe** the architectural views of IoT and various design challenges
CO 3. **Illustrate** data link and network layer protocols.
CO 4. **Analyze** various transport and session layer Protocols
CO 5. **Explain** the need of IoT service layer protocols

Reference/ Text Books:

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications,2016
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2015
3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642- 19156-5 e-ISBN 978-3-642-19157-2, Springer, 2016
4. N. Ida, Sensors, Actuators, and Their Interfaces, Scitech Publishers, 2014

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	3	1	1	1	1	1	3	2	-
CO2	3	3	3	2	3	1	1	1	1	1	1	3	2	-
CO3	3	3	3	2	3	1	2	1	1	1	1	3	2	-
CO4	3	3	3	2	3	1	2	1	1	1	1	3	3	-
CO5	3	3	3	2	3	1	1	1	1	1	1	3	2	-

1 - Slightly; 2 - Moderately; 3 – Substantially

Data Sciences in IoT: 2220505

COURSE OBJECTIVES

- To understand the key technologies in analytics for IoT.
- To understand the IoT data and requirements of analysis.
- To gain practical, hands-on experience with statistics programming languages, tools.

Unit-I: Introduction to Data Science, IoT Analytics and Challenges, Data Analytics Life Cycle, IoT Analytics for the Cloud, Types of Analytics: Streaming Analytics, Spatial, Time Series, and Prescriptive Analytics, various fields, and impact of Data Science in IoT, data lakes, Data retention strategy.

Unit-II: Introduction to Data Acquisition, Types of Data, Multi-Dimensional Data, Data collection strategies, Digital Data, Source of data and IoT data, CSV and JSON Dataof IoT system, Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis, Inferential Statistics, sampling Distribution, Hypothesis Testing.

Unit-III: **Introduction to Data wrangling**: Exploratory Data Analytics, Feature engineering with IoT data, Missing value analysis, Data Cleaning and Transformation, Feature Improvements, Feature Selection, Feature Extraction and Handling Outliers, and Outlier Detection Analysis.
Unit-IV: Introduction to Data Visualization and Representation, Model Evaluation using Visualization, different kind of plotting: Line, Scatter, Bar, Histogram, Residual Plot, Distribution Plot, Box Plots, Pivot Table, Heat Map and Correlation Matrix.

Unit-V: Model Development using Simple and Multiple Regression, Polynomial Regression, and Pipelines in IoT data, Measures for In-sample Evaluation, Prediction, and Decision-making, IoT-based applications, Healthcare, Marketing, Finance, Smart Cities, Agriculture, and Weather Forecasting, and other domains; Real Time IoT-based data analysis.

Course Outcomes: After completion of this course, the students would be able to:

CO1: **Explain** the fundamentals of data science and its importance concerning IoT.
CO2: **Describe** data and the role of statistical techniques in IoT data.
CO3: **Describe** the pre-processing and data-wrangling strategies.
CO4: **Apply** the different data visualization and representation techniques for IoT applications
CO5: **Design** the different real-time applications and evaluate the performance of IoT-based projects.

Reference Books/ Text Books:

1. JojoMoolayil, "Smarter Decisions: The Intersection of IoT and Data Science", PACKT, 2016.
2. Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly, 2015.
3. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013.
4. Andrew Minteer, Analytics for the Internet of Things "IoT" (1 ed.), Packt Publishing, 2017. ISBN 978-1787120730.
5. HwaiyuGeng, Internet of Things and Data Analytics Handbook (1st st ed.), Wiley, 2017. ISBN 978-1119173649.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	2	1	1	1	1	1	1	3	-	-
CO2	3	2	1	1	3	1	1	1	1	1	1	3	-	-
CO3	3	3	3	3	3	2	1	1	1	1	2	3	-	-
CO4	3	2	2	1	3	2	1	1	1	1	3	3	-	-
CO5	3	3	3	3	3	3	2	1	1	1	3	3	-	-

1 - Slightly; 2 – Moderately; 3 – Substantially

Smart Energy Analytics: 220701

Course Objective:

- The course covers fundamental concepts, methodologies, and practical applications of data science and machine learning techniques in optimizing and enhancing hybrid energy system performance.
- The students will be able to learn how to leverage data-driven approaches to maximize efficiency, reliability, and performance in the design, operation, and maintenance of hybrid energy systems.

Unit 1: Data visualization using matplotlib- creating a simple plot, line plot, and sub plot, bar plots, histogram, pie chart, grids and scatter plotting, Data Statistics- Mean, Standard Deviation, Skewness and Kurtosis.

Unit 2: Traditional Programming Vs Machine learning, Key Elements of Machine Learning: Representation, process (Data Collection, Data Preparation, Model selection, Model Training, Model Evaluation and Prediction), Useful Libraries for ML, Pandas - Data Prep, Numpy- Statistics and modelling

Unit 3: Conventional and renewable energy resources, Components and working of Solar PV plants, Wind energy system and Grid power supply, Advantages and disadvantages of renewable energy resources.

Unit 4: Overview and need of hybrid energy systems, Integration of renewable sources with grid supply: Block diagram representation, operation in composite climate and testing, Precautions and Maintenance measures of hybrid energy systems.

Unit 5: Exploratory data analysis and visualization to improve hybrid energy system performance using power-time plots, Statistical analysis of energy data using time series analysis, Application of clustering and dimensionality reduction to energy system data.

Course outcomes (CO): After successful completion of course students will be able to:

CO1. **Develop** proficiency in data visualization, data statistics using python programming.

CO2. **Explain** Pandas and Numpy for data prep, statistics, and modeling.

CO3. **Explain** renewable energy resources, hybrid systems, and their characteristics.

CO4. **Apply** data analysis and visualization techniques to optimize hybrid energy system performance.

CO5. **Implement** data-driven techniques for energy management and forecasting, including real-tim optimization strategies to enhance energy utilization.

Reference/ Text Books:

1. Programing and Problem Solving with Python by A.N. Kamthane and A.A. Kamthane, Mc Graw Hi Education (India) Pvt. Ltd.
2. Machine Learning by Tomm. Mitchell, Mc Graw Hill Education (India) Pvt. Ltd.
3. Data Science with Jupyter by Prateek Gupta, bpb press.
4. Machine Learning in Data Science using Python by Dr. R. Nageswara Rao, Dream Tech Press, Ind
5. Renewable Energy Technologies- A Practical Guide for beginners by Chetan Singh Solanki, P Learning Pvt. Ltd.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	1	2	1	1	1	1	1	2	3	-	-
CO2	3	2	1	2	3	1	2	1	1	1	2	3	-	-
CO3	3	3	3	3	3	2	1	1	1	1	2	3	-	-
CO4	3	2	2	1	3	2	1	1	1	1	3	3	-	-
CO5	3	3	3	3	3	3	2	1	1	1	3	3	-	-

1 - Slightly; 2 - Moderately; 3 – Substantially

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute affiliated to RGPV, Bhopal)

Department of Electrical Engineering

Advance IoT Applications (220702)

Course Objective:

- To understand the advance application and vision of IoT from a global context.
- Make the students to apply IoT data for advance applications in various domain in secured manner

Unit I- Introduction to IoT Systems: Introduction to Internet of Things: IoT: Definition and importance, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Three-layer and Five-layer model of IoT. IoT Communication network: Architecture of IoT,

Unit II- IoT in Smart Grid: Introduction to Smart Grid, Application of IoT for energy management in Smart Grid, Integrated Architecture of IoT and Smart Grid, Smart Grid Security Services based on IoT, Challenges in IoT for Smart Grid, Benefits of IoT in Smart Grid.

Unit III- IoT in Agriculture: Introduction of Agricultural IoT, Sensors used in Smart Agriculture., Architecture of Agricultural IoT, Features of Agricultural IoT, IoT based Smart Irrigation System, Crop management using IoT.

Unit IV- IoT in Air Quality Monitoring: Need for air quality monitoring, Air quality: Pollutants and standards, Introduction to air quality sensors, Calibration techniques for IoT, Air quality sensors, Sensor types: Semiconductor and electrochemical, Air quality: Overview of system design, Real time measurement for drive cycle.

Unit V- IoT in Healthcare: Internet of Medical Things: Introduction and system architecture: IoT Devices- On-Body Devices, In Home Devices, Community Devices, In-Clinic Devices, In Hospital Devices ,IoT System Architecture-Data Collection Layer, Data Management Layer, Medical Server Layer

Recommended Books:

- Internet of Things: Architecture, Design Principles and Applications, Rajkamal, McGraw Hill Higher Education, 2012.
- Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015.
- Chakraborty, C., Banerjee, A., Kolekar, M. H., Garg, L., & Chakraborty, B. (Eds.). Internet of things for healthcare technologies. Springer, 2021.
- Iqbal, Muhammad Azhar, Sajjad Hussain, Huanlai Xing, and Muhammad Ali Imran. Enabling the internet of things: fundamentals, design and applications. John Wiley & Sons, 2020.

Text Books:

- Ghosh, Uttam, Chinmay Chakraborty, Lalit Garg, and Gautam Srivastava, eds. Intelligent Internet of Things for Healthcare and Industry. Berlin: Springer, 2022.
- Dhaou, Imed Saad Ben, Aron Kondoro, Syed Rameez Ullah Kakakhel, Tomi Westerlund, and Hannu Tenhunen. "Internet of Things Technologies for Smart Grid." In Research Anthology on Smart Grid and Microgrid Development, pp. 805-832. IGI Global, 2022.

Couse Outcomes:

After the completion of this course, the students would be able to:

CO1: Explain the application and usages of the internet of things in different contexts.
CO2: Understand the key components and applications of IoT in Smart Grid.
CO3: Explain and implementation of IoT application for value creations.
CO4: Design and devlop of IoT architecture used to monitor the air quality.
CO5: Implementation of IoT architecture for healthcare system.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	1	1	1	1	1	3	-	-
CO2	3	3	3	3	3	2	1	1	1	1	1	3	-	-
CO3	3	3	3	3	2	2	1	1	1	1	1	3	-	-
CO4	3	3	3	3	3	2	2	1	1	1	1	3	-	-
CO5	3	3	2	3	2	2	1	1	1	1	1	3	-	-

1 - Slightly; 2 - Moderately; 3 – Substantially

IoT & Its Applications: 910203

Course Objective:

- To understand basic terminology of IoT, its structure, and protocols, Sensors, Devices, Components and integrated development environment, to organize and analyze the vast data of IoT and to develop different IoT applications.

Unit I: Introduction to IoT and network architecture– Evolution of Internet of Things (IoT), IoT Components, Impact of IoT, Challenges and security issues in IoT. IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture: Core IoT Functional Stack, IoT data management and compute stack (Cloud, edge, fog).

Unit II: IoT Protocols: Communication Protocols: IEEE 802.15.4, Zigbee, 6LoWPAN, Z-Wave, Bluetooth, RFID. Networking Protocols: CoAP and MQTT.

Unit III: Things in IoT: Sensor: light sensor, moisture sensor, temperature sensor, etc. Actuator: DC motor, different types of actuators. Controllers: microcontrollers and their role as a gateway to interfacing sensors and actuators. **IoT Platform overview:** Raspberry pi, Arduino Board details, Introduction to Arduino IDE, Embedded 'C' Language basics, Interfacing sensors, LEDs.

Unit IV: Cloud computing and data analytics in IoT: Introduction to Cloud Computing-Definition, Characteristics, Components, Cloud provider: Microsoft Azure, AWS, Google Cloud. Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring Organizing in IoT.

Unit V: IoT Applications: Business models for the internet of things, Smart city, Smart mobility an transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Sma Agriculture, Examples for new trends – AI, ML penetration to IoT

Recommended Books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
3. Internet of Things: Architecture, Design Principles and Applications, Rajkamal, McGraw Hill Higher Educati

Course Outcomes

At the end of the course, student will be able to:

CO1: **Define** basic understanding of IoT, its architecture.
CO2: **Compare** the communication models and protocols for IoT.
CO3: **Implement** hardware and software platforms for application in IoT.
CO4: **Examine** the security issues involved in IoT.
CO5: **Choose** appropriate data analytics and cloud offerings related to IoT.
CO6: **Develop** IoT based applications for real world.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO
CO1	3	3	3	3	2	1	1	1	1	1	1	2	3	3
CO2	3	3	3	3	2	3	1	1	1	1	1	2	3	3
CO3	3	3	3	3	3	3	2	2	2	1	1	2	3	3
CO4	3	3	3	3	3	3	2	3	2	1	1	2	3	3
CO5	3	3	3	3	3	3	2	2	2	1	1	2	3	3
CO6	3	3	3	3	3	3	3	2	3	2	2	3	3	3

1 - Slightly; 2 - Moderately; 3 – Substantially

910226_Smart Energy Analytics

Course Objective:

- The course covers fundamental concepts, methodologies, and practical applications of data science and machine learning techniques in optimizing and enhancing hybrid energy system performance.
- The students will be able to learn how to leverage data-driven approaches to maximize efficiency, reliability, and performance in the design, operation, and maintenance of hybrid energy systems.

Unit 1: Data visualization using matplotlib- creating a simple plot, line plot, and sub plot, bar plots, histogram, pie chart, grids and scatter plotting, Data Statistics- Mean, Standard Deviation, Skewness and Kurtosis.

Unit 2: Traditional Programming Vs Machine learning, Key Elements of Machine Learning: Representation, process (Data Collection, Data Preparation, Model selection, Model Training, Model Evaluation and Prediction), Useful Libraries for ML, Pandas - Data Prep, Numpy- Statistics and modelling

Unit 3: Conventional and renewable energy resources, Components and working of Solar PV plants, Wind energy system and Grid power supply, Advantages and disadvantages of renewable energy resources.

Unit 4: Overview and need of hybrid energy systems, Integration of renewable sources with grid supply: Block diagram representation, operation in composite climate and testing, Precautions and Maintenance measures of hybrid energy systems.

Unit 5: Exploratory data analysis and visualization to improve hybrid energy system performance using power-time plots, Statistical analysis of energy data using time series analysis, Application of clustering and dimensionality reduction to energy system data.

Course outcomes (CO): After successful completion of course students will be able to:

CO1. **Develop** proficiency in data visualization, data statistics using python programming.

CO2. **Explain** Pandas and Numpy for data prep, statistics, and modeling.

CO3. **Explain** renewable energy resources, hybrid systems, and their characteristics.

CO4. **Apply** data analysis and visualization techniques to optimize hybrid energy system performance.

CO5. **Implement** data-driven techniques for energy management and forecasting, including real-tin optimization strategies to enhance energy utilization.

Reference/ Text Books:

1. Programing and Problem Solving with Python by A.N. Kamthane and A.A. Kamthane, Mc Graw H Education (India) Pvt. Ltd.
2. Machine Learning by Tomm. Mitchell, Mc Graw Hill Education (India) Pvt. Ltd.
3. Data Science with Jupyter by Prateek Gupta, bpb press.
4. Machine Learning in Data Science using Python by Dr. R. Nageswara Rao, Dream Tech Press, Inc
5. Renewable Energy Technologies- A Practical Guide for beginners by Chetan Singh Solanki, I Learning Pvt. Ltd.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	1	2	1	1	1	1	1	2	3	-	-
CO2	3	2	1	2	3	1	2	1	1	1	2	3	-	-
CO3	3	3	3	3	3	2	1	1	1	1	2	3	-	-
CO4	3	2	2	1	3	2	1	1	1	1	3	3	-	-
CO5	3	3	3	3	3	3	2	1	1	1	3	3	-	-

1 - Slightly; 2 - Moderately; 3 – Substantially