Curriculum for BE Degree Course in

Biomedical Engineering

Regulation 2024

CHENNAI INSTITUTE OF TECHNOLOGY
(Autonomous)

Document Version

Version Number	Date	Author	Major Updates	Approved by
1.0	27.03.2024	Mr.K.Pradeep	Complete curriculum and syllabus	HOD BME
1.1	17.04.2024	Dr.Jai Jaganath Babu	Subject code changes	HOD BME
1.2	26.04.2024	Mrs. Uma Haimavathi K	Elective codes and Mathematics syllabus	HOD BME
1.3	20.05.2024	Mrs. Priyanka SA	Open electives changed	HOD BME
1.4	08.06.2024	Ms. Sasimekala MM	Mandatory course changed	HOD BME
1.5	27.06.2024	Ms.Ramya	BOS changes incorporated	HOD BME
1.6	02.08.2024	Ms.Shrinidhi GS	Professional elective and open electives code changed	HOD BME

Section 1: General Course Structure

A. Definition of Credit:

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
1 Hour Practical (P) per week	0.5 Credit

B. Structure of Program

S. No.	Category	Credits
1	Humanities & Social Science Courses (HSMC)	10
2	Basic Science Courses (BSC)	16
3	Engineering Science Courses (ESC)	43
4	Program Core Courses (PCC)	52
5	Professional Elective Courses (PEC)	18
6	Open Elective Courses (OEC)	6
7	Employability Enhancement Skills (EES)	18
8	Mandatory Course (MC)	0
	TOTAL	**163**

v

C. Course code and definition

Code	Definition
L	Lecture
T	Tutorial
P	Practical
C	Credits

- **Course level coding scheme:** Four-digit number used as suffix with the Course Code for identifying the level of the course. Thousand's place denotes regulation number (we use "3" for 2022-23 Regulation) Digit at hundred's place signifies the semester in which course is offered. Last two digits represent the serial order of course within the semester. For example, 3101, 3102, … are courses offered during first semester.

D. Category-wise Courses

Humanities & Social Science Courses (HSMC)

S. No.	Course Title	Semester	L-T-P-C
1	தமிழர் மரபு / Heritage of Tamils	1	1-0-0-1
2	Communicative English – I	1	3-0-2-4
3	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	2	1-0-0-1
4	Communicative English – II	2	3-0-2-4
	Total Credits		**10**

Basic Science Courses (BSC)

S. No.	Course Title	Semester	L-T-P-C
1	Mathematics-I Calculus and Linear Algebra	1	3-1-0-4
2	Engineering Physics	1	3-0-2-4
3	Mathematics-II Probability and Statistics	2	3-1-0-4

4	Mathematics-III Mathematical methods for Engineering	3	3-1-0-4
		Total Credits	**16**

Engineering Science Courses (ESC)

S. No.	Course Title	Semester	L-T-P-C
1	Problem Solving Using C Programming	1	3-0-2-4
2	Basics of Electrical and Electronics Engineering	2	3-0-2-4
3	Data structures using C programming	2	3-0-2-4
4	Electronics Devices and Circuits	3	3-0-2-4
5	Signal Processing	3	3-0-2-4
6	Object oriented Programming with Java	3	3-0-2-4
7	Analog and Digital Integrated Circuits	4	3-0-2-4
8	Analog and Digital Communication	4	3-0-1-3
9	Microprocessors and Microcontrollers	4	3-0-2-4
10	Artificial Intelligence and Machine learning	4	3-0-2-4
11	Medical Informatics	6	3-0-2-4
		Total Credits	**43**

Program Core Courses (PCC)

S. No.	Course Title	Semester	L-T-P-C
1	Anatomy and Physiology	1	3-0-2-4
2	Medical Physics	2	3-0-0-3
3	Bioscience for Medical Engineering	2	3-0-2-4
4	Control system for Biomedical engineering	3	3-0-0-3
5	Sensors and Measurements	3	3-0-0-3
6	Core Course Project-I	3	0-0-2-1
7	Biomedical Instrumentation	4	3-0-2-4
8	Biomechatronics	4	3-0-0-3
9	Core Course Project-II	4	0-0-2-1
10	Medical Imaging Systems	5	3-0-0-3
11	Biomaterials	5	3-0-0-3
12	Embedded C and IOMT	5	3-0-2-4
13	Diagnostic and Therapeutic Equipment	5	3-0-2-4
14	Bio and E Waste Management	5	3-0-0-3
15	Core Course Project-III	5	0-0-2-1
16	Medical Image processing	6	3-0-2-4
17	Healthcare Analytics	6	3-0-0-3
18	Core Course Project-IV	6	0-0-2-1
		Total Credits	**52**

Professional Elective courses

S. No.	Course Title	Semester	L-T-P-C
1	Professional Elective – I	V	3-0-0-3
2	Professional Elective – II	V	3-0-0-3
3	Professional Elective – III	VI	3-0-0-3

4	Professional Elective – IV	VI	3-0-0-3
5	Professional Elective – V	VII	3-0-0-3
6	Professional Elective – VI	VII	3-0-2-3
		Total Credits	**18**

Open Elective Courses (OEC)

S. No.	Course Title	Semester	L-T-P-C
1	Open Elective – I	VI	3-0-0-3
2	Open Elective – II	VII	3-0-0-3
		Total Credits	**6**

Employability Enhancement Skills

S. No.	Course Title	Semester	L-T-P-C
1	Employability Enhancement Skills– I	1	0-0-2-1
2	Employability Enhancement Skills– II	2	0-0-2-1
3	Employability Enhancement Skills– III	3	0-0-2-1
4	Employability Enhancement Skills– IV	4	0-0-2-1
5	Employability Enhancement Skills– V	5	0-0-2-1
6	Hospital training/Internship	6	0-0-2-1
7	Project phase I	7	0-0-18-9
8	Project phase II	8	0-0-6-3
		Total Credits	**18**

Mandatory Course (MC)

S. No.	Course Title	Semester	L-T-P-C
1	Introduction to Women and Gender Studies	3	1-0-0-0
2	Elements for Literature	3	1-0-0-0
3	Film Appreciation	3	1-0-0-0
4	Disaster Management	3	1-0-0-0
5	Design Thinking	3	1-0-0-0
6	Environmental Science and Sustainability	3	1-0-0-0
7	Well Being with Traditional practices (Yogam Ayurveda and Siddha)	4	1-0-0-0
8	History of Science and Technology in India	4	1-0-0-0
9	Political and Economic Thought for a Humane Society	4	1-0-0-0
10	State, Nation building and Politics in India	4	1-0-0-0
11	Industrial Safety	4	1-0-0-0
		Total Credits	**0**

E. Induction Program

- ***Catapult*** is a dynamic week-long event designed for our incoming first-year students, offering an immersive introduction to the diverse array of clubs and activities across the college campus. In addition to familiarizing them with our labs and Centers of Excellence (COEs), Catapult aims to acclimate first-year

students to college life, ensuring they feel at ease with the forthcoming experiences of their four-year journey.

- This initiative fosters meaningful connections between seniors and juniors, providing a platform for them to explore departmental projects and engage in collaborative activities, thereby enhancing camaraderie and knowledge sharing within the college community.

F. Evaluation Scheme

a. For Theory Courses:

The weightage of Internal assessment is 40% and for End Semester Exam is 60%
The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass

b. For Practical Courses:

The weightage of Internal assessment is 60% and for End Semester Exam is 40%
For Theory cum Lab
The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass.

c. For Theory Cum Practical Courses:

The weightage of Internal assessment is 50% and for End Semester Exam is 50%
The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass

Note: The internal assessment is based on the student's performance in 3 Internal Assessment (IA) exams, quizzes, assignments, class performance, attendance, etc.

d. For Project works:

Assessment of project works comprises three internal reviews and an end-of-semester evaluation. Internal reviews, worth 40 marks in total, encompass assessment criteria such as Project Synopsis/Proposal Evaluation, Methodology and Design of Existing System, Feasibility of Project Proposal, Planning of Project Work, and Team Work. At the conclusion of the semester, 20 marks are designated for assessing the quality of the report, while the remaining 40 marks are reserved for evaluating performance in viva-voce, demonstration of the work, and other relevant factors.

G. Learning Beyond Class Room

a. Students should be encouraged to visit Centers of Excellence (COEs) in the campus and learn additional technical skills
b. Students should be encouraged to participate in internal / external competitions, hackathons, etc. on a regular basis

Section 2: Semester wise Structure and Curriculum for UG Course in BE Biomedical Engineering

Semester I							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1		IP4101	Induction Programme	-	-	-	-
2	Theory	MA4101	Mathematics I Calculus and Linear Algebra	3	1	0	4
3	Theory	HS4101	தமிழர் மரபு / Heritage of Tamils	1	0	0	1
4	T&P	HS4102	Communicative English – I	3	0	2	4
5	T&P	PH4101	Engineering Physics	3	0	2	4
6	T&P	CS4111	Problem Solving Using C Programming	3	0	2	4
7	T&P	BM4101	Anatomy and Physiology	3	0	2	4
8	Practical	ES4101	Employability Enhancement Skills – I	0	0	2	1
						Total	**22**

Semester II							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	Theory	MA4201	Mathematics-II Probability and Statistics	3	1	0	4
2	Theory	BM4201	Medical Physics	3	0	0	3
3	Theory	HS4201	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	1	0	0	1
4	T&P	HS4202	Communicative English – II	3	0	2	4
5	T&P	BM4202	Bioscience for Medical Engineering	3	0	2	4
6	T&P	EC4211	Basics of Electrical and Electronics Engineering	3	0	2	4
7	T&P	CS4211	Data structures using C programming	3	0	2	4
8	Practical	ES4201	Employability Enhancement Skills – II	0	0	2	1
9			NCC skill level training	2	0	0	2*
						Total	**25**

* NCC Credit Course Level 1 ARMY WING additional credits in Appendix D

Semester III							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	Theory	MA4301	Mathematics-III Mathematical Methods for Engineering	3	1	0	4
2	Theory	BM4301	Control system for Biomedical engineering	3	0	0	3
3	Theory	BM4302	Sensors and Measurements	3	0	0	3
4	T&P	EC4311	Electronics devices and circuits	3	0	2	4
5	T&P	EC4312	Signal Processing	3	0	2	4
6	T&P	CS4311	Object oriented Programming with Java	3	0	2	4
7	Practical	BM4303	Core Course Project-1	0	0	2	1
8	Practical	ES4301	Employability Enhancement Skills – III	0	0	2	1
9	Theory	MC43**	Mandatory course -I	1	0	0	0
						Total	**24**

Semester IV							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	Theory	BM4401	Biomechatronics	3	0	0	3
2	Theory	EC4411	Analog and Digital Communication	3	0	0	3
3	T&P	BM4402	Biomedical Instrumentation	3	0	2	4
4	T&P	EC4412	Analog and Digital Integrated Circuits	3	0	2	4
5	T&P	EC4413	Microprocessors and Microcontrollers	3	0	2	4
6	T&P	CS4411	Artificial Intelligence and Machine learning	3	0	2	4
7	Practical	BM4403	Core Course Project-II	0	0	2	1
8	Practical	ES4401	Employability Enhancement Skills – IV	0	0	2	1
9	Theory	MC44**	Mandatory course -II	1	0	0	0
			NCC skill level training	2	0	0	2*
						Total	**24**

NCC Credit Course Level 2 NAVAL WING*

Semester V							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	Theory	BM4501	Medical Imaging Systems	3	0	0	3
2	Theory	BM4502	Biomaterials	3	0	0	3
3	Theory	BM4503	Bio and E Waste Management	3	0	0	3
4	Theory	BM4V**	Professional Elective I	3	0	0	3
5	Theory	BM4V**	Professional Elective II	3	0	0	3
6	T&P	BM4504	Diagnostic and Therapeutic Equipment	3	0	2	4
7	T&P	BM4505	Embedded C and IOMT	3	0	2	4
8	Practical	BM4506	Core Course Project-III	0	0	2	1
9	Practical	ES4501	Employability Enhancement Skills – V	0	0	2	1
						Total	**25**

Semester VI							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	Theory	BM4601	Healthcare Analytics	3	0	0	3
2	Theory	BM4V**	Professional Elective III	3	0	0	3
3	Theory	BM4V**	Professional Elective IV	3	0	0	3
4	Theory	**46O*	Open Elective - I	3	0	0	3
5	T&P	BM4602	Medical Image processing	3	0	2	4
6	T&P	CS 4612	Medical Informatics	3	0	2	4
7	Practical	BM4603	Hospital training/ Internship	0	0	2	1
8	Practical	BM4604	Core Course Project-IV	0	0	2	1
9			NCC skill level training	2	0	0	2*
						Total	**22**

NCC Credit Course Level 3 AIR FORCE WING

Semester VII							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	Theory	BM4V**	Professional Elective V	3	0	0	3
2	Theory	BM4V**	Professional Elective VI	3	0	0	3
3	Theory	**46O*	Open Elective II	3	0	0	3
4	Practical	BM4701	Project Phase I	0	0	18	9
						Total	**18**
Semester VIII							

S. No	Theory/ Practical / T&P	Course Code	Course Title	L	T	P	C
1.	Practical	BM4801	Project Phase II	0	0	6	3
						Total	**3**

Semester I

Course Code		L	T	P	C
MA4101	**Calculus and Linear Algebra**	3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize the students with differential calculus.
- To acquire the knowledge of evaluating integrals and their applications.
- To introduce the concept of ordinary differential equations in engineering problems.
- To develop the use of matrix algebra techniques for practical applications.
- To acquire the knowledge of vector spaces and linear transformation in all engineering disciplines.

UNIT I: DIFFERENTIAL CALCULUS **12**

Representation of a function - Limits - Continuity – Derivatives- Mean Value theorem - Rolle's theorem - Maclaurin series - Partial derivatives - Total derivatives - Taylors series - Maxima and minima.

UNIT II: INTEGRAL CALCULUS **12**

Multiple Integration: Double and Triple integrals - Change of order of integration in double integrals - Change of variables (Cartesian to polar) -Volume of solids - Gradient - Curl - Divergence - Theorems of Green in a plane - Gauss and Stokes theorems (Excluding Proof).

UNIT III: DIFFERENTIAL EQUATIONS **12**

First order linear and nonlinear differential equations - Higher order linear differential equations with constant coefficients - Method of Variation of Parameters - Cauchy's and Legendre's equations - Solution of partial differential equations.

UNIT IV: LINEAR ALGEBRA **12**

Matrices: Determinants - rank of a matrix - System of linear equations (Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan) - Eigen Values - Eigen Vectors - Reduce the quadratic form into Canonical form - LU decomposition - Singular Value Decomposition.

UNIT V: VECTOR SPACES AND LINEAR TRANSFORMATIONS **12**

Vector Space – Subspace - linear dependence and independence - bases and dimensions - Linear transformations - Null space - range - Dimension theorem - Matrix representation of a linear transformations.

TOTAL: 60 PERIODS

Course Format

Lectures and Solving , Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Apply differential calculus tools in solving various applications in real situations.

CO2: Able to use the integral ideas in solving areas, volumes and other practical problems.

CO3: Apply various techniques in solving ordinary differential equations.

CO4: Recalling the matrix algebra methods for solving the practical problems.

CO5: Understand the concepts of vector spaces and applications of linear transformations.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. Friedberg. A.H., Insel. A.J, and Spence. L ., "Linear Algebra", Prentice Hall of India, New Delhi, 4th Edition, 2004.

REFERENCES:

1. Weir, M.D and Joel Hass, "Thomas Calculus", Pearson India, 12thEdition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi,2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I& II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
6. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
7. Glyn James, "Advanced Modern Engineering Mathematics", Pearson India, Eighth Edition, 2017.

8. Kumaresan. S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.

Course Code	Heritage of Tamils	L	T	P	C
HS4101		1	0	0	1

UNIT I Language and Literature **3**

Language Families in India – Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature – Management Principles in Thirukural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan.

UNIT II Heritage – Rock Art Paintings to Modern Art – Sculpture **3**

Hero stone to modern sculpture – Bronze icons – Tribes and their handicrafts – Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments – Mridhangam, Parai, Veenai, Yazh and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils

UNIT III Folk and Martial Arts **3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils.

UNIT IV Thinai Concept of Tamils **3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas.

UNIT V Contribution of Tamils to Indian National Movement and Indian Culture **3**

Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self – Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

1. Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi – Sangam City Civilization on the banks of river Vaigai (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

6. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL).

Course Code	**Communicative English – I**	L	T	P	C
HS4102		3	0	2	4

COURSE OBJECTIVES:

1. To improve the communication competency.
2. To learn basic grammatical structures in suitable contexts.
3. To build students English language skills through LSRW exercises.
4. To enable the students to write in English precisely and effectively.
5. To develop language proficiency in expressing their opinions.

INTRODUCTION TO EFFECTIVE COMMUNICATION 1

What is effective communication? Why is communication critical for excellence during study, research, and work? What are the seven C's of effective communication?

UNIT I – INTEGRALS OF COMMUNICATION (GREETINGS & INTRODUCTION) 8

Listening – Listening comprehensions, listening to news.
Speaking- Just A Minute, Introducing a friend
Reading- Reading Comprehension /Newspaper / Articles/ Magazines
Writing –Letter of Introduction, Developing the Hints
Vocabulary – Synonyms/Antonyms, Acquaintance with Prefixes/ suffixes from foreign languages in
English to form derivatives &Word formation
Grammar – Parts of Speech, Mixed Tenses, Active/Passive Voice

UNIT II – GIVING AND RECEIVING INSTRUCTIONS 9

Listening – Listening to short stories, Narrations & Persuasive Speech
Speaking- Giving Instructions to use the Product/ Presenting or summarizing about a product
Reading – Reading Advertisements /Biographies
Writing – Instructions, Paragraph Writing
Vocabulary – Abbreviation, Acronyms, One-word Substitutes
Grammar – WH Questions/Yes or No Questions, Imperatives

UNIT III – DESCRIBING PEOPLE AND PLACES 9

Listening- Listen to the description of a product
Speaking –Picture Description, Narrating personal experiences and events
Reading- Gadget Reviews, User Manuals
Writing–Recommendations, Product/ Process Description.
Vocabulary – Homonyms, Homophones, Compound Words
Grammar – Adjectives, Adverbs, Articles.

UNIT IV –VISUALIZATION AND CLASSIFICATION 9

Listening – TED talks

Speaking- Interviewing a celebrity/Famous Personality
Reading – Company profiles, Business Letters
Writing – Interpretation of Charts and Graphs
Vocabulary – Discourse markers, Linking words and Phrases, Collocations.
Grammar – Pronouns, Conjunction, Preposition

UNIT V – EXPOSITION **9**

Listening- Watching Movies& Listening Dialogue &Conversations
Speaking- Role play, Panel Discussion, Debate
Reading- Blogs, Novels, Short Stories
Writing – Descriptive Essay, Dialogue Writing
Vocabulary – Phrasal verbs
Grammar–Simple/Compound/Complex Sentences, Error Spotting, Punctuation.

THEORY – 45

PERIODS

List of Exercises:

1. Extempore (oral)
2. Conversation on asking directions
3. Picture Description, about purchasing a product
4. Summarizing a TED talk
5. Role play
6. Academic Journals in online through OER (Open Educational Resources)

PRACTICAL: 30PERIODS
TOTAL: 75 PERIODS

Course Format

Lectures and discussions, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, 3 Internal Assessments, Final Examination

COURSE OUTCOMES

At the end of the course, learners will be able
CO1: To use appropriate words in a professional context
CO2: To gain an understanding of basic grammatical structures and use them in the right context.
CO3: To write definitions, descriptions, narrations and essays on various topics
CO4: To speak fluently and accurately in formal and informal communicative contexts
CO5**:** To express their opinions effectively in both oral and written medium of communication.

TEXT BOOKS:

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021.Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
3. Professional English-II, V.K.Publications, Dr.S.N. Mahalakshmi.

REFERENCES:

1. Technical Communication – Principles And Practices By Meenakshi Raman &Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book On Technical English ByLakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. Learning to Communicate–Dr.V.Chellammal. Allied Publishers, NewDelhi,2003

Course Code	Engineering Physics	L	T	P	C
PH4101		3	0	2	4

COURSE OBJECTIVES:

1. To enable students to understand the mechanics and properties of matter.
2. To provide an overview of sound and ultrasonic production, detection and applications.
3. To introduce the basics of lasers.
4. To enrich the basic knowledge of optical fiber
5. To understand quantum mechanical phenomena and apply them in computing fields.

UNIT I MECHANICS AND PROPERTIES OF MATTER **9**

Center of mass (CM) – motion of the CM – moment of inertia – theorems of M. I – moment of inertia of continuous bodies (Ring, Disc) – gyroscope.Elasticity –Type of modulus: Young's Modulus, Bulk Modulus, Rigidity Modulus –Poisson ratio - Hooke's law – stress-strain diagram – Factors affecting elasticity – bending of Beams – Young's modulus by uniform bending and non–uniform bending – Torsional Pendulum – I – shaped girders.

UNIT II ACOUSTICS AND ULTRASONICS **9**

Acoustics: Classification and characteristics of sound – decibel – Weber – Fechner law – Factors affecting acoustics of buildings and their remedies – Absorption Coefficient. -Doppler effect. Ultrasonic – Production of Ultrasonic by Magnetostriction and piezoelectric methods – acoustic grating – Non-destructive testing – Pulse-echo system through transmission and reflection modes – A, B and C – scan displays.

UNIT III LASER **9**

Laser: Characteristics – Spontaneous and stimulated emission – Pumping methods – Optical Resonator – Active medium and Active center – Einstein's coefficient – Principles of Laser – population inversion- Components Laser systems - Types of laser – Nd – YAG laser, CO_2 laser, Semiconductor lasers: homojunction and heterojunction - Industrial and medical application

UNIT IV FIBRE OPTICS **9**

Fiber optics – Principle, Numerical aperture and acceptance angle – types of optical fibers (material, refractive index, mode) – Attenuation, Dispersion – Fiber Optical Communication system (Block diagram) – Displacement sensors- Temperature/Pressure sensors –Optical

fibers in computers - Medical Applications: Endoscope.

UNIT V QUANTUM MECHANICS **9**

Blackbody Radiation - Planck's quantum theory – Compton effect – Particle properties of wave: Matter waves, wave function – The Schrodinger equation (Time-dependent and time-independent forms) – Particle in an infinite potential well: One Dimensional Box –Qubit-Quantum computing – the role of Quantum computing in advancing Artificial intelligence.

THEORY: 45 PERIODS

PRACTICAL EXERCISES (FIVE ONLY)

1. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
2. Non-Uniform bending – Determination of Young's modulus.
3. Uniform bending – Determination of Young's modulus.
4. Laser – Determination of the wavelength of the laser using grating.
5. Optical fiber – Determination of Numerical Aperture and acceptance angle.
6. Acoustic grating – Determination of velocity of ultrasonic waves in liquids.
7. Michelson Interferometer.

PRACTICAL: 30 PERIODS

TOTAL: 75 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES

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

CO1: Understand the importance of mechanics and express their knowledge in properties of matter

CO2: Analyze the applications of acoustics and ultrasonic in engineering field.

CO3: Acquire knowledge in laser and its applications

CO4: Demonstrate a strong foundational knowledge in fiber optics.

CO5: Comprehend and apply quantum mechanical principles.

TEXT BOOKS

1. D. Kleppner and R. Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw – Hill (Indian Edition), 2017.

3. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2009.
4. Kasap, Safa, Capper, " Handbook of Electronic and Photonic Materials"2nd edition, Springer,2017.
5. Eleanor Rleffel and Wolfgang Polak, "Quantum computing a gentle introduction", 1st edition,The MIT press,2012.

REFERENCES

1. R. Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition),2009.
2. K. Thyagarajan and A. Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
3. D. Halliday, R. Resnick, and J. Walker. Principles of Physics, Wiley (Indian Edition), 2015.
4. Hugh D. Young, Roger A. Freedman, A. Lewis Ford, Searls and Zemansky University Physics, 2009.
5. David J. Griffiths, "Introduction to Quantum Mechanics", 2nd edition, Cambridge University Press, 2017.

WEB REFERENCES

1. Advanced Quantum Mechanics With Applications – https://nptel.ac.in/courses/115103104
2. Quantum Mechanics And Molecular Spectroscopy – https://nptel.ac.in/courses/104101126
3. Fiber Optic Communication Technology – https://nptel.ac.in/courses/108106167
4. Introduction To Photonics – https://nptel.ac.in/courses/108106135
5. Introduction To Laser – https://nptel.ac.in/courses/115102124
6. Biomedical Ultrasound - https://nptel.ac.in/courses/121108458

Course Code	**Problem Solving Using C Programming**	L	T	P	C
CS4111		3	0	2	4

COURSE OBJECTIVES:

- To understand the basic programing constructs of C Language
- To develop C programming using arrays and strings
- To develop modular applications in C using functions and pointers
- To develop applications in C using structs and unions
- To do input/output and file handling in C

UNIT I Basics of C Programming **15**

Introduction to programming paradigms – Structure of C program – Creating C programs – Variables, Keywords, Data types, Constants, Operators, input / output statements – Decision making statements – Looping with while, do-while, and for loops – Nested loops and loop control statements

Coding Exercises

1. Write a C program to find the sum of two integers entered by the user
2. Write a C program to check if a given number is even or odd
3. Write a C program to find the largest among three numbers using if-else statements

Problems-solving Assignments

1. Write a C program to calculate the factorial of a given positive integer using a loop
2. Write a C program to check if a given number is a prime number
3. Write a C program to find the GCD (Greatest Common Divisor) of two numbers using a function

UNIT II Arrays and Strings **15**

Working with arrays: One dimensional array: declaration, initialization, and accessing elements – Two dimensional arrays: Declaration -Initialization – Accessing elements – Operations: Read – Print – Sum – Transpose, Strings in C: string functions and manipulation – linear and binary Search, Selection sort

Coding Exercises

1. Implement a program that finds the largest element in an array of integers
2. Write a C program to count the number of vowels and consonants in a given string
3. Write a program to reverse a string without using the standard string library functions

Problems-solving Assignments

1. Write a C program to merge two sorted arrays into a single sorted array
2. Write a C program to find the second largest element in an array
3. Write a program that finds the intersection of two arrays and stores the result in a third array

UNIT III Functions and Pointers **15**

Modular programming – Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion– Parameter passing: Pass by value, Pass by reference– Introduction to pointers and memory management – Pointer operators – Pointer arithmetic - Pointers and arrays

Coding Exercises

1. Write a C program to exchange the values of variables
2. Implement a recursive function to calculate the factorial of a given number

Problems-solving Assignments

1. Write a C program to sort an array of strings in alphabetical order using function
2. Create a program to implement a binary search algorithm to search for an element in a sorted array using recursion

UNIT IV Structure and Union **15**

Structure – Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation – Singly linked list – Typedef – Union – Storage classes and Visibility

Coding Exercises

1. Write a C program to find the average and total marks of students using a structure

Problems-solving Assignments

1. Write a C program to create a structure representing a book with title, author, and publication year. Implement functions to add, display, and search for books in a library
2. Implement a program to manage a student database using structs, including functions to add, delete, and display student records

UNIT V File Processing **15**

Files – Types of file processing: Sequential access, Random access – Sequential access file – Random access file – Command line arguments – Code optimization and best practices

Coding Exercises:

1. Create a program that reads data from a file and calculates the average of a set of numbers
2. Write a program to copy the contents of one file into another file

Problems-solving Assignments:

1. Write a C program to read student records from a file and calculate their total and percentage
2. Develop a program to read employee details from a file, sort them based on salary, and write the sorted data back to the file

Final Project (sample): Design a simple inventory management system for a small store using structs and file handling. The program should allow users to add, update, and delete items in the inventory and display the current stock

TOTAL (THEORY AND PRACTICAL): 75 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: After completion of the course, students will be able to:

CO1: Demonstrate knowledge on C Programming constructs
CO2: Design and implement applications using arrays and strings
CO3: Develop and implement modular applications in C using functions and pointers
CO4: Develop applications in C using structures and unions
CO5: Develop applications using sequential and random-access file processing

TEXT BOOKS

1. Kernighan, B.W and Ritchie, D.M, "The C Programming language", Second Edition, Pearson Education, 2015.
2. Paul Deitel and Harvey Deitel, "C How to Program", 9th edition, Pearson, 2021
3. E Balagurusamy, "Programming in ANSI C", Eighth Edition, McGraw Hill Education, 2019.

REFERENCE BOOKS

1. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
2. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
3. Peter van der Linden, "Expert C Programming", Pearson, 1994.
4. Reema Thareja, "Programming In C", Second Edition, Oxford University Press India, 2016.

Course Code	**Anatomy And Human Physiology**	L	T	P	C
BM4101		3	0	2	4

COURSE OBJECTIVES:

- To identify all the organelles of an human body cell and their function
- To understand structure and functions skeletal, muscular and respiratory systems
- To demonstrate the knowledge of importance of anatomical features & physiology of cardiovascular and lymphatic systems
- To demonstrate the knowledge of importance of anatomical features & physiology of nervous and endocrine systems
- To demonstrate the knowledge of importance of anatomical features & physiology of digestive & urinary systems and sense organs

UNIT I Basic Structure, Function of Human Cell And Tissues 9

Structure of Cell – structure and functions of sub organelles – Cell Membrane –Transport of Across Cell Membrane - Action Potential – Cell to Cell Signaling – Cell Division - Mitosis. Types of specialized tissues-Functions.

UNIT II Skeletal, Muscular and Respiratory Systems 9

Skeletal::Types of Bone and function – Physiology of Bone formation – Division of Skeleton – Types of joints-articulation and function – Types of cartilage and function. **Muscular:** Parts of Muscle –Movements. **Respiratory:** Parts of Respiratory Systems – Types of respiration - Mechanisms of Breathing – Regulation of Respiration

UNIT III Cardiovascular and Lymphatic Systems 9

Cardiovascular: Components of Blood and functions.- Blood Groups and importance – Structure of Heart – Conducting System of Heart – Properties of Cardiac Muscle - Cardiac Cycle - Heart Beat – Types of Blood vessel – Regulation of Heart rate and Blood pressure. **Lymphatic:** Parts and Functions of Lymphatic systems – Types of Lymphatic organs and vessels

UNIT IV Nervous and Endocrine Systems 9

Nervous: Cells of Nervous systems – Types of Neuron and Synapses – Mechanisms of Nerve impulse – SBrain : Parts of Brain – Spinal Cord – Tract and Pathways of Spines – Reflex Mechanism – Classification of Nerves - Autonomic Nervous systems and its functions. **Endocrine - Pituitary** and thyroid gland.

UNIT V Digestive & Urinary Systems and Sense Organs 9

Digestive: Organs of Digestive system – Digestion and Absorption. **Urinary:** Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System – Urinary reflex, Sense Organs: Eye and Ear.

45 PERIODS

LIST OF EXPERIMENTS

1. Collection of Blood Samples
2. Identification of Blood groups (Forward and Reverse)
3. Bleeding and Clotting time
4. Estimation of Hemoglobin
5. Total RBC Count
6. Total WBC Count
7. Differential count of Blood cells
8. Estimation of ESR
9. PCV, MCH, MCV, MCHC
10. Hearing test – Tuning fork
11. Visual Activity – Snellen's Chart and Jaeger's Chart

30 PERIODS
TOTAL: 75 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: After successful completion of the course, the students will be able to:

CO1: Demonstrate the basic structure and functions of human body
CO2: Have knowledge on skeletal and muscular systems and respiratory systems
CO3: Comprehend circulatory and lymphatic system with their components
CO4: Enumerate the structure and function of nervous system
CO5: Study importance of digestive and urinary systems in human body

TEXT BOOKS:

1. Elaine.N. Marieb, "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi, 2007
2. Prabhjot Kaur."Text Book of Anatomy and Physiology", Lotus Publsihers. 2014

3. Guyton & Hall, "Medical Physiology", 13th Edition, Elsevier Saunders, 2015.

REFERENCES:

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, Fundamentals of Anatomy and Physiology. Pearson Publishers, 2014
2. William F.Ganong, "Review of Medical Physiology", 22nd Edition, Mc Graw Hill, New Delhi
3. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W.B. Saunders

Course Code	**Employability Enhancement Skills – I**	L	T	P	C
ES4101		0	0	2	1

COURSE OBJECTIVES:

- To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.
- To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.
- To critically evaluate numerous possibilities related to puzzles

UNIT I Numbers **6**

Introduction – Classification of numbers – Formation of Numbers (Small & Large) –Place Value – Face Value – Divisibility Rule – Prime, Composite Numbers – Prime Factorization – Number of factors – Number of factors (Odd & Even) – Sum of factors – Successors and Predecessors – Greatest Integer Value – Vedic Mathematics – Trailing Zeroes – Unit Digits–Remainder Theorem – Real Number – Rational Numbers: Integers, Fractions – Comparison of Numbers – Operations on fractions – Scientific Notation

UNIT II Problems on Letters, Numbers and Symbols **6**

Factors and Multiples, LCM and HCF – Relationship between LCM and HCF – Factorial – Simplification – VBODMAS – Square, Square Root – Cube, Cube Root – Exponents & Powers (Surds and Indices) – Sequence & Series: Arithmetic Progression – Geometric Progression – Special Progression, Letter Series, Number Series, Alpha – Numeric Series, Continuous Pattern Series

UNIT III Verbal and Non – Verbal Reasoning **6**

Verbal Reasoning – Analogy: Completing the Analogous pair, Direct Analogy, Choosing the Analogous pair, Double Analogy, Choosing a Similar Word, Detecting Analogies, Multiple word Analogy, Number Analogy, Alphabet Analogy – Classification: Odd Words and Numerals – Coding and Decoding: Letter, Number, Symbol, Matrix, Substitution, Deciphering Message Word, Number and Symbols. Non – Verbal Reasoning Figure Series – Missing figure, Incorrect figure – Analogy: Similarity Related Pair, Similarity Related figures, unrelated figures, Group of figures.

UNIT IV Ratio and Proportion **6**

Introduction – Ratio – Proportion: Direct and Indirect – Unitary Method – Problems on Ages – Chain Rule – Partnership – Mixture or Allegation – Time and Work: Individual, Group, Efficiency, Wages – Pipes and Cistern: Inlet, Outlet, and Leakage

UNIT V Percentage **6**

Introduction – Percentages in real life – Profit and Loss – Discount – Simple Interest – Compound Interest – Relationship between Simple Interest and Compound Interest – Overhead Expenses and GST.

TOTAL: 30 PERIODS

Course Format

Lectures and discussion, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: After the completion of the course, students will be able to

CO1: Develop the arithmetic ability and properties of numbers that we use in day to day life,
CO2: Demonstrate the logic behind the formation of numbers, alphabets series.
CO3: Apply the reasoning methods logically and evaluate complex relationships between the variables and numbers.
CO4: Use the concept of ratios and proportion in ages and partnership problems.
CO5: Apply the short cuts of the mathematical tricks to reduce the time duration in problem solving

TEXT BOOKS

1. "Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal – 2022"
2. "Teach Yourself Quantitative Aptitude" by Arun Sharma – 2017
3. "A modern approach verbal and non – verbal reasoning" by R.S. Aggarwal – 2017

REFERENCES

1. "Shortcuts in Mathematics" by Akhilesh Khare – 2016
2. "Vedic maths for competitive exams" by Ravi Shankar – 2016
3. "Quantitative Aptitude for Competitive Examination" by Abhijit Guha – 2017

Semester II

Course Code	Probability and Statistics	L	T	P	C
MA4201		3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the basic concepts of probability and distributions.
- To learn the basic concepts of two -dimensional random variables.
- To acquire the knowledge in random processes, stationary, Markov and Poisson process.
- To acquire the knowledge of testing of hypothesis for small and large samples this plays an important role in real life problems.
- To summarise the design of experiments in the field of agriculture.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability: Axioms – Sample space – Events - Conditional Probability – Baye's Theorem - Discrete and continuous random variables - Moments - Moment generating functions - Standard distributions: Binomial - Poisson - Geometric - Uniform - Exponential and Normal distributions.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions - Marginal and conditional distributions - Covariance - Correlation - linear regression - Transformation of random variables - Central limit theorem (excluding proof).

UNIT III RANDOM PROCESSES AND MARKOV CHAINS 12

Random Processes: Introduction and Classification -Stationary Processes -Markov Processes - Poisson Processes -Discrete Parameter Markov Chains -Chapman-Kolmogorov Equations (Statement only) -Limiting Distributions.

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters **-**Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t, F and Chi-square distributions for mean, variance **-** Contingency table (test for independent) - Goodness of fit.

UNIT V DESIGN OF EXPERIMENTS 12

One way and two-way classifications - Completely randomized design - Randomized block design - Latin square design.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamental knowledge of the concepts of probability and have knowledge of Standard distributions which can describe real life phenomenon.
CO2: Recognize the basic concepts of two - dimensional random variables and apply in engineering applications.
CO3: Develop the basic concepts of random processes which are widely used in engineering fields.
CO4: Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO5: Investigate of design of experiments in the field of agriculture.

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, 3 Internal Assessments, Final Examination

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
3. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

Course Code	Medical Physics	L	T	P	C
BM4201		3	0	0	3

COURSE OBJECTIVS:

- To provide understanding of the application of the radiation concepts and methods of Physics in Medical science
- To acquire the basics of atomic physics and non-ionizing radiation.
- To inculcate the principal behind Senses and Radioactive nuclides.
- To gain the knowledge of interaction of radiation and its effects in human body.
- To apply the knowledge in detectors and dosimeters

UNIT I Electromagnetic Radiation **9**

Electromagnetic spectrum –– Non-ionizing radiation overview and its Effects - Low Frequency Effects- Higher frequency effects -Tissue as a leaky dielectric. Thermography and radiofrequency ablation (RFA) – Application of electromagnetic radiation in medicine.

UNIT II Physics in Sensory System and Application of Sound **9**

Cutaneous sensation – Physics of Visible Light – limits of vision and color vision -Ear- mechanism of hearing - Physics of sound, Normal sound levels, ultrasound fundamentals, Generation of ultrasound (Ultrasound Transducer), Interaction of Ultrasound with matter- Cavitations, Reflection, Transmission, Scanning methods, Artifacts, Ultrasound- Doppler effect, Clinical Applications.

UNIT III Interaction of Radiation and Radionuclides in Medicine **9**

Interaction of charged particles with matter – –Specific ionization, Linear energy transfer range, Bremsstrahlung- Interaction of X and Gamma radiation with matter- Photoelectric effect, Compton Scattering, Pair production and Annihilation, Interaction of neutron with matter and their clinical significance. Radioactive Decay – Sources of Radioisotopes Natural and Artificial radioactivity, Production of radionuclide – Cyclotron produced Radionuclide-Technetium generator.

UNIT IV Radiation Exposure and its Effects in Health **9**

Dose and Exposure measurements – Units (SI), Inverse square law, Maximum permissible exposure Interaction coefficients – mass attenuation coefficients, mass energy transfer coefficients, mass energy absorption coefficient, stopping power Radiation biology – effects of radiation, concept of LD 50, Stochastic and Non-stochastic effects, Radiation Syndrome

UNIT V Principles of Radiation Detection and Dosimeters **9**

Principles of Radiation detection – properties of dosimeters - Theory of gas filled detectors – Ion chamber dosimetry systems - free air ion chamber - ionization chamber - GM counter – scintillation detections

THEORY: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: After the completion of the course, students will be able to

CO1: Interpret the basics of atomic physics and electromagnetic radiation (Understand)
CO2: Classify the types of senses, vision and audition (Apply)
CO3: Examine the interaction of radiation with matter and its clinical significance (Apply)
CO4: Identify the radiation exposure, dosage effects and radiation biology (Apply)
CO5: Utilize the basic concepts of radiation detection and dosimeters (Apply)

TEXT BOOKS:

1. Brown B. H., Smallwood R. H., Barber D., Lawford P. V and Hose D. R., "Medical Physics and Biomedical Engineering", 1st edition, CRC Press, 2017
2. Gopal B. Saha., "Physics and Radiobiology of Nuclear Medicine", 4th edition, Springer, 2013
3. Woodcock J. P., "Ultrasonics Medical Physics Handbook - 1", 1st Edition, Adam Hilger Ltd, Bristol, 2002.

REFERENCES:

1. Meredith W. J. and Massey J. B., "Fundamental Physics of Radiology", 1st Edition, Varghese Publishing house, 1992
2. Muhammad Maqbool- "An Introduction to Medical Physics", Reprinted 1st edition, Springer, 2018
3. Attix F H, "Introduction to Radiological Physics and Radiation dosimetry", 1st Edition, Viley-VCH, Verlog, 2004
4. https://nptel.ac.in/courses/115103101

Course Code	**Tamils And Technology**	L	T	P	C
HS4201		1	0	0	1

UNIT I Weaving and Ceramic Technology **3**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II Design and Construction Technology **3**

Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other

worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.

UNIT III Manufacturing Technology **3**

Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold Coins as source of history – Minting of Coins – Beads making – industries Stone beads – Glass beads – Terracotta beads – Shell beads/ bone beats – Archeological evidences – Gem stone types described in Silappathikaram.

UNIT IV Agriculture and Irrigation Technology **3**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.

UNIT V Scientific Tamil & Tamil Computing **3**

Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL: 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi – 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	**Communicative English –II**	L	T	P	C
HS4202		3	0	2	4

COURSE OBJECTIVES:

1. To engage learners in meaningful language activities to improve their LSRW skills
2. To enhance learners awareness of general rules of writing for specific audiences

3. To help learners understand the purpose, audience, contexts of different types of writing
4. To develop analytical thinking skills for problem solving in communicative contexts
5. To cultivate the learners to understand of job applications and interviews for internship and placements.

UNIT I –MAKING COMPARISONS **9**

Listening – Evaluative Listening: Advertisements, Product Descriptions, –Audio/ video
Speaking –Marketing a product, Persuasive Speech Techniques.
Reading – Reading advertisements, user manuals, brochures
Writing – Letter to the editor; Compare and Contrast Essay
Grammar – Impersonal passive voice; Prepositional phrases
Vocabulary –Contextual meaning of words

UNIT II –EXPRESSING CASUAL RELATIONS IN SPEAKING AND WRITING **9**

Listening – Listening to longer technical talks and completing–gap filling exercises. Listening technical information from podcasts
Speaking –Describing and discussing the reasons of accidents or disasters based on news reports
Reading – Reading longer technical texts/Novels
Writing – Writing responses to complaints; Problem solution Essay
Grammar –Subject – Verb Agreement, Infinitive and Gerunds
Vocabulary – Adverbs.

UNIT III –PROBLEM SOLVING **9**

Listening– Watching movie scenes/documentaries depicting a technical problem and suggesting solutions.
Speaking – Group Discussion (based on case studies), – techniques and Strategies.
Reading – Case Studies, excerpts from literary texts, news reports etc.
Writing – Checklists, Argumentative Essay
Grammar –Error correction, If conditional sentences
Vocabulary – Compound Words, Sentence Completion.

UNIT IV- REPORTING OF EVENTS AND RESEARCH **9**

Listening – Listening Comprehension based on news reports and documentaries.
Speaking –Interviewing, Presenting an oral report, Mini presentations on select topics
Reading –Newspaper articles
Writing –Industrial visit Report, Accident Report, Survey Report
Grammar–Reported Speech, Modals
Vocabulary–Conjunctions, use of prepositions.

UNIT V –THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY **9**

Listening – Listening to TED Talks, Presentations, Formal job interviews
Speaking – Mock Interview, Making presentations with visual aids
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals

Writing –Job / Internship application – Cover letter with Resume
Grammar – Numerical adjectives, Relative Clauses
Vocabulary–Idioms.

THEORY – 45 PERIODS

List of Exercises:

1. Listening /Reading Comprehension
2. Introducing Oneself
3. Summary of a Podcast
4. Mini Presentation on General topic (ICT tools)
5. Autobiography of a famous Personality
6. Narrating an unforgettable event
7. Drafting an Email (printed format)
8. Developing a story using given Vocabulary
9. Group Discussion
10. Mock Interview

PRACTICAL: 30 PERIODS

TOTAL: 75 PERIODS

Course Format

Lectures and discussions, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1. Compare and contrast products and ideas in technical texts.
CO2. Identify cause and effects in events, industrial processes through technical texts
CO3. Analyze problems in order to arrive at feasible solutions and communicate them orally and in the written format.
CO4. Report events and the processes of technical and industrial nature.
CO5. Present their opinions in a planned and logical manner, and draft effective resumes incontext of job search.

TEXTBOOKS:

1. English for Engineers & Technologists (2020edition) Orient Blacks wan Private Ltd. Department of English, Anna University.

2. English for Science & Technology Cambridge University Press 2021. Authored by Dr.Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

3. Professional English-II, V.K. Publications, Dr.S.N. Mahalakshmi.

REFERENCES:

1. Raman. Meenakshi, Sharma.Sangeeta (2019), Professional English,Oxford university press. NewDelhi.
2. Improve Your Writing V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
3. Learning to Communicate–Dr.V.Chellammal. Allied Publishers, NewDelhi,2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001,NewDelhi.

Course Code	**Bioscience for Medical Engineering**	L	T	P	C
BM4202		3	0	2	4

COURSE OBJECTIVES:

- To emphasize the role of biomolecules by providing basic information on specific metabolic diseases and disorders of these biomolecules
- Gain a knowledge cell injury, healing and tumors
- Know the etiology of pathological diseases
- Know about tools to examine microorganism
- Know about mechanism of immunology

UNIT I Fundamentals to Biochemistry **9**

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson - Hasselbalch equation, physiological buffers in living systems, Energy in living organism. Properties of water and their applications in biological systems. Introduction to Biomolecules, Biological membrane, Clinical application of Electrolytes and radioisotopes.

Laboratory experiments:

1. Estimation of blood glucose.
2. General tests for carbohydrates, proteins and lipids.

UNIT II Cell Degeneration, Repair and Neoplasia **9**

Cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification, cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours. Autopsy and biopsy.

Laboratory experiments:

1. Histopathological slides of benign and malignant tumours.
2. Study of parts of compound microscope

UNIT III Fluid and Hemodynamic **9**

Edema, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock. Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas.

Laboratory Experiments:

1. Slides of malarial parasites, micro filaria and leishmania donovani.
2. Haematology slides of anemia and leukemia. Study of bone marrow charts.
3. Estimation of Bleeding time and clotting time

UNIT IV Microscopes and Microbial Cultures **9**

Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM & SEM). Staining methods – simple, gram staining and AFB staining. Morphological features and structural organization of bacteria, growth curve, identification of bacteria.

Laboratory Experiments:

1. Simple stain.
2. Gram stain.
3. AFB stain.

UNIT V Immunology **9**

Natural and artificial immunity, opsonization, phagocytosis, inflammation, Immune deficiency syndrome, antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immune electrophoresis, RIA and ELISA, monoclonal antibodies. Disease caused by bacteria, fungi, protozoal, virus and helminths.

Laboratory experiments:

1. Hemoglobin estimation
2. Study of ELISA reader

TOTAL (THEORY AND PRACTICAL): 75 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: After completion of the course, students will be able to:

CO1: Understand the fundamentals of biochemistry
CO2: Analyze the cell injury, healing and tumors
CO3: Enumerate the fluid and hemodynamic techniques.
CO4: Analyze the development of bacteria using various staining methods and study of various microscopes
CO5: Illustrate the methods to increase the immunity

TEXT BOOKS:

1. David.W.Martin, Peter.A.Mayes, Victor. W.Rodwell, “Harper‟s Review of Biochemistry”, LANGE Medical Publications, 1981

2. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009.
3. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", 7th edition,
4. Prescott, Harley and Klein, "Microbiology", 5th edition, McGraw Hill, 2002 (Units IV & V)
5. Ananthanarayanan & Panicker, "Microbiology" Orientblackswan, 2005.

REFERENCES:

1. Pamela.C.Champe & Richard.A.Harvey, "Lippincott Biochemistry Lippincott‟s Illustrated Reviews", Raven publishers, 1994.
2. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
3. Dubey RC and Maheswari DK. "A Text Book of Microbiology" Chand & Company Ltd, 2007

Course Code	Basic Of Electrical And Electronics Engineering	L	T	P	C
EC4211		3	0	2	4

COURSE OBJECTIVES:

- To solve an electric network by applying basic laws and theorems.
- To understand the Transient and Resonance in RLC circuits.
- To learn the concept of DC and AC motors and generators.
- To understand the working principle of electronic devices
- To learn principle of digital electronic

UNIT I Basic Circuits Analysis and Network Theory 9

Active elements - Passive elements – Sources – Elements in series and parallel connections – Ohm's Law and Kirchoff's Law - Voltage and Current division method, Voltage and Current Sources - independent, dependent, ideal and practical, Nodal analysis and Mesh analysis in networks. Circuit analysis techniques: Linearity and Superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Network Reduction : Delta-Wye Conversion.

UNIT II Transients and Resonance in RLC Circuit 9

Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit-Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Voltage and Current Sources - independent, dependent, ideal and practical, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor

UNIT III DC Machines AC Machines and Transformer 9

DC motor - Construction, principle of operation - Types- Torque equation, Construction and principle of DC generator, motor-EMF equation -AC motor- Construction, principle of operation, Types, Single phase and Three phase of AC Motors, Construction and principle of AC Generator. Construction and principle of Single phase transformer-Torque equation Special Motors : Construction and principle of Steppermotor, Servo motor and BDLC motor, Relay - Working principle of Relay, Types of Circuit Breaker

UNIT IV Basic of Electronics 9

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics-Rectifier circuits Peak, average and rms values of ac quantities; Apparent, active and reactive powers; Phasor analysis, impedance and admittance-Wave shaping. Working principle - BJT, SCR, JFET, MOSFET

UNIT V Basic of Digital Electronics **9**

Number system-Logic gates – Truth tables – NOT, AND, OR, NOR, NAND, XOR, XNOR - Boolean Laws and theorems – Solving Boolean expressions- Truth Tables and Logic circuits – The Karnaugh Map – half adder-full adder

THEORY: 45 PERIODS

LABORATORY EXPERIMENTS

1. Estimation of voltage and current by KVL and KCL in Electric Circuits
2. Determination of mesh current and node voltage by Mesh and Nodal Analysis
3. Apply Superposition Theorem in Electrical Circuits
4. Apply Reciprocity Theorem in Electrical Circuits
5. Application of thevenin‟s theorem for Maximum Power Transfer
6. Apply Norton and Compensation Theorem in Electrical Circuits
7. Determination of series and parallel resonance frequency response of circuits.
8. Determination of transient current in RL, RC and RLC circuits
9. Measurement of three phase power?
10. How does a circuit breaker work?
11. How to Check Earthing at Home?
12. Analysis of no-load and load characteristics of separately excited DC generator.
13. Examine the Speed Control methods of DC shunt motor
14. Sketching of the equivalent circuit parameters of a single phase transformer.
15. Testing of transformers
16. Verification of Three phase Transformer connection

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: After successful completion of the course, the students will be able to:

CO1: Solve an electric network by applying basic laws and theorems
CO2: Develop and understand resonance in RLC circuits
CO3: Capable of understanding the operating principle of DC &AC machines.
CO4: Be able to understand the operating principle of electronics devices
CO5: Develop the insight in Digital electronics.

TEXT BOOKS:

1. Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", Mc Graw Hill education, 9th Edition, 2018.
2. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", Mc Graw-Hill, 2nd Edition, 2003.
3. Kothari D PandI. J Nagrath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education, 2014.
4. John Bird, “Electrical Circuit theory and technology”, Routledge; 5thEdition,2013.
5. Thomas L. Floyd, ‘Electronic Devices’, Pearson Education, 10th Edition, 2018.
6. Morris and Mano Digital Fundamentals by, PHI
7. Floyd & Jain Digital Fundamentals by, Pearsons Publication

REFERENCES:

1. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014. David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7thEdition, 2009
2. John O Mallay, Schaum’s Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2nd Edition, 2011
3. Allan H.Robbins, Wilhelm C.Miller, —Circuit Analysis Theory and Practice||, Cengage Learning, Fifth Edition, 1st Indian Reprint 2013
4. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill, 2015.

Course Code	**Data Structures Using C Programming**	L	T	P	C
CS4204		3	0	2	4

COURSE OBJECTIVES:

- To understand the basic concepts of linear data structures like arrays and linked lists.
- To grasp the concept of stacks and queues as a linear data structure and the operations upon them.
- To understand the fundamental concepts of hierarchical Tree data structures.
- To explore optimization strategies for indexing structures and graph algorithms.
- To understand the concept of searching for quick data retrieval, sorting for arranging data, hash functions strategies for optimized data storage.

UNIT I Lists **12**

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of lists – Polynomial ADT – Radix Sort – Multilists.

Coding Exercises:

1. Write a C programs to implement single linked list ADT to perform following operations.
   a) insert an element into a list.
   b) delete an element from list.
   c) search for a key element in list.
   d) count number of nodes in list.
2. Write a C programs to implement doubly linked list ADT to perform following operations.

a) insert an element into a list at the end.
b) delete middle element from list.
c) print the element in reverse order.

3. Write a C programs to Perform Polynomial Addition using singly linked list.

Problems-solving Assignments:

1. Write a program to multiply every element of the linked list with 10.
2. Write a program to input an n digit number. Now, break this number into its individual digits and then store every single digit in a separate node thereby forming a linked list.

For example, if you enter 12345, then there will 5 nodes in the list containing nodes with values 1, 2, 3, 4, 5.

UNIT II Stacks and Queues **12**

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – DeQueue – Applications of Queues.

Coding Exercises:

1. Write a C programs to implement a stack operations push, pop, top, and is Empty using a linked list.
2. Write a C programs to implement a queue operations enqueue, dequeue, front, is Empty using a linked list.
3. Write C programs to Convert Infix to Postfix Expression using Stack ADT.

Problems-solving Assignments:

1. Write a program to implement a stack that stores names of students in the class.
2. Write a program to implement a stack using a linked list
3. Write a program to create a queue which permits insertion at any vacant location at the rear end.

UNIT III Trees **12**

Tree ADT – Tree Traversals – Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees – Splay trees- Red Black Tree -Priority Queue (Heaps) – Binary Heap.

Coding Exercises:

1. Write a C programs to implement a binary search tree with the following operations:
   a. Insert an element into a binary search tree.
   b. Delete an element from a binary search tree.
   c. Search for a key element in a binary search tree.
2. Write a C programs that use recursive functions to traverse the given binary tree.
   a) Preorder b) inorder c) postorder.
3. Write C programs to implement an AVL Tree.

Problems-solving Assignments:

1. Write a C program for a Splay Tree for insertion and search operations.
2. Write a C program to implementation the insertion operation for a Red-Black Tree.

3. Write a C program a Max-Heap data structure operations insert(), extractMax(), and getMax().

UNIT IV Indexing and Graphs **12**

Indexing-B-Tree – B+ Tree. Graph Definition – Representation of Graphs – Types of Graphs – Breadth-first traversal – Depth-first traversal – Bi-connectivity – Euler circuits – Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm.

Coding Exercises:

1. Write a C program that demonstrates B-Tree operation insertion, search, and display.
2. Write a C program for Dijkstra's single source shortest path algorithm.
3. Write a C program for Prim's Minimum Spanning Tree (MST) algorithm.

Problems-solving Assignments:

1. Write a C program that demonstrates Breadth-First Traversal (BFS) in a graph using an adjacency list representation.
2. Write a C program that demonstrates topological sorting using Depth-First Search (DFS) on a directed acyclic graph.
3. Write a C program that demonstrates Kruskal's algorithm for finding the Minimum Spanning Tree (MST) of a graph.

UNIT V Searching, Sorting and Hashing Techniques **12**

Searching – Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort –. Merge Sort – Quick Sort. Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

Coding Exercises:

1. Write a C programs to implement binary search using a recursive function.
2. Write a C program to implement the Insertion Sort algorithm.
3. Write a C program to implement the separate chaining technique in hashing.

Problems-solving Assignments:

1. Write a C program to implement the linear search algorithm using a nonrecursive approach.
2. Write a C program to implement the Quick Sort algorithm.
3. Write a C program to implement a hash table with rehashing.

TOTAL (THEORY AND PRACTICAL): 60 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: After successful completion of the course, the students will be able to

CO1: Articulate linear data structures and legal operations permitted on them.
CO2: Implement stack and queue using array and linked list.
CO3: Articulate Tree data structures and legal operations permitted on them.
CO4: Understand the indexing and graph concepts and applications to solve different real time problems.
CO5: Apply a suitable algorithm for searching, sorting and hashing.

TEXT BOOKS

1. Mark Allen Weiss, — Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 1996
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008.
3. Data Structures Using C-Aaron M. Tenenbaum, Yedidyah Langsam, Moshe Augenstein, Pearson Education, 2018.

REFERENCES:

1. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, —Data Structures and Algorithms, Pearson Education, 1983.
2. Robert Kruse, C.L.Tondo, Bruce Leung, Shashi Mogalla, — Data Structures and Program Design in C, Second Edition, Pearson Education, 2007
3. Jean-Paul Tremblay and Paul G. Sorenson, —An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, 1991.

Course Code	**Employability Enhancement Skills – II**	L	T	P	C
ES4201		0	0	2	1

COURSE OBJECTIVES:

- To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.
- To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.
- To critically evaluate numerous possibilities related to puzzles.

UNIT I Time and Distance **6**

Introduction – Speed: Late / Early / Usual Time – Average Speed – Chasing – Problems on Train: Crossing Pole, Crossing Platform, Train moving in same and different direction – Boats and Streams: Upstream, Downstream – Clock – Calendar.

UNIT II Probability and Statistics **6**

Introduction – Algebra of Events – Addition theorem of Probability – Permutation and Combinations – Problems based on choosing the objects – Statistics: Range – frequency, Arithmetic Mean – Median – Mode – Variance – Standard Deviation – Measures of Dispersion – Coefficient of Variation.

UNIT III Arithmetic and Logical Reasoning **6**

Introduction – Mathematical Operations – Blood Relations: Direct, Indirect, coded – Problems on Cubes and Dices: Face identification – Folding and cutting Images – Counting technique of figures – Distance & Direction

UNIT IV Applied Mathematics **6**

Mensuration (2D&3D): Square, Rectangle, Triangle, Circle, Parallelogram, Rhombus, Trapezoid, Quadrilateral, Cube, Cuboid, Cylinder, Cone, Sphere, Miscellaneous – Trigonometry: Ratio, Identities, Heights and Distances – Algebra – Logarithm – Geometry.

UNIT V Verbal and Logical Reasoning **6**

Introduction – Venn diagram – Syllogism – Data Sufficiency – Decision Making – Puzzle: Number Puzzle, Letter Puzzle – Ranking Test – Data Arrangement: Linear, Circular, Miscellaneous – Critical Reasoning.

TOTAL: 30 PERIODS

Course Format

Lectures and discussion, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: After the completion of the course, students will be able to

CO1: Use their logical thinking and analytical abilities to solve Quantitative aptitude questions from company specific and other competitive tests.
CO2: Solve questions related to Time etc. from company specific and other competitive tests.
CO3: Illustrate and solve puzzle related questions from specific and other competitive tests

TEXT BOOKS:

1. "Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal – 2022"
2. "Teach Yourself Quantitative Aptitude" by Arun Sharma – 2017
3. "A modern approach verbal and non – verbal reasoning" by R.S. Aggarwal – 2017

REFERENCES:

1. "Shortcuts in Mathematics" by Akhilesh Khare – 2016
2. "Vedic maths for competitive exams" by Ravi Shankar – 2016
3. "Quantitative Aptitude for Competitive Examination" by Abhijit Guha – 2017

SEMESTER III

Course Code		L	T	P	C
MA4301	**Mathematical Methods for Engineering**	3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To apply the concept of Laplace transforms in engineering problems.
- To introduce the concepts of Z transforms.
- To learn the basic concepts of Fourier series and Fourier transforms.
- To use the numerical techniques of differentiation and integration in engineering and technology disciplines.

UNIT I ANALYTIC FUNCTION & COMPLEX INTEGRATION 12

Analytic functions - Cauchy-Riemann equations (statement only) - Complex integration - Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series - Zeros - Singular points - Residues - Cauchy's residue theorem (statement only) - Evaluation of contour integrals on simple closed curves.

UNIT II LAPLACE TRANSFORMS 12

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorem - Transforms of derivatives and integrals - Initial and final value theorem - Inverse transforms - Convolution theorem - Transform of periodic functions - Application - solution of linear second order ordinary differential equations with constant coefficients.

UNIT III Z-TRANSFORMS 12

Elementary properties - Inverse Z-transform (using partial fraction and residues) - Initial and final value theorems - Convolution theorem - Formation of difference equations - Solution of difference equations using Z - transform.

UNIT IV FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Change of interval - Half range Sine series –Half range Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT V FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

TOTAL: 60 PERIODS

Course Format

Lectures and discussions, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

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

CO1: Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.
CO2: Apply Laplace transform and inverse transform of simple functions, properties, various related problems.
CO3: Understand the characteristics and properties of Z – transform.
CO4: Recognize the concepts of Fourier series and Fourier Transform and applying engineering problems.
CO5: Develop the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration in Engineering problems.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John WileyandSons,10th Edition, New Delhi, 2016.
3. Sankara Rao . K, "Numerical Methods for Scientists and Engineers", PHI Learning Pvt Ltd., New Delhi, 2007.

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REFERENCES:

1. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., Advanced Engineering Mathematics||, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics ||, Narosa Publications, New Delhi, 3rd Edition, 2007.
5. O'Neil, P.V. Advanced Engineering Mathematics||, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
6. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
7. S. Ponnusamy, "Foundations of Complex Analysis" 2nd Edition, Narosa Publishing House, 2014.

Course Code	**Control System For Biomedical Engineering**	L	T	P	C
BM4301		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To understand the concept behind feedback and continuum in various systems and subsystems.

- To analyze the systems in time and frequency domain and to understand the concept of stability.
- To apply mathematical modelling principles in understanding the various fundamental biological systems.
- To analyze biological systems models using MATLAB.

UNIT I Introduction to Control System **9**

Open and Closed loop Systems, Modeling and Block Diagrams, Block diagram and signal flow graph representation of systems, reduction of block diagram and signal flow graph, Introduction to Physiological control systems- Illustration, Difference between engineering and physiological control system.

UNIT II Time Response Analysis **9**

Step and impulse responses of first order and second order systems, time domain specifications of first and second order systems, steady state error constants, Definition of stability, Routh-Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability.

UNIT III Frequency Response Analysis **9**

Frequency domain specifications - Polar plots, Bode plots, Nyquist plot, Nyquist stability criterion, closed loop stability, Constant M and N circles, Nichol's chart

UNIT IV Biological System Models **9**

Distributed parameter versus lumped parameter models, Model development of Cardiovascular system- Heart model-circulatory model, Pulmonary mechanics- Lung tissue visco- elastance-chest wall- airways, Interaction of Pulmonary and Cardiovascular models, Static analysis of physiological systems – Regulation of cardiac output, Regulation of ventilation.

UNIT V Biological Control System Analysis **9**

Simple models of muscle stretch reflex action, Study of steady state analysis of muscle stretch reflex action, Study of transient response analysis of neuromuscular reflex model action, Study of frequency response of circulatory control model, Stability analysis of Pupillary light reflex.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the need for mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological systems
CO2: Analyze the time response of various systems and discuss the concept of system stability
CO3: Analyze the frequency response characteristics of various systems using different charts

CO4: Understand the concept of modeling basic physiological systems
CO5: Comprehend the application aspects of time and frequency response analysis in physiological control systems.

TEXT BOOKS:

1. I.J. Nagarath and M. Gopal, "Control Systems Engineering", Fifth Edition, Anshan Publishers, 2008.
2. Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall of India, 2005

REFERENCES:

1. Benjamin C. Kuo, "Automatic Control Systems", Prentice Hall of India, 1995.
2. John Enderle Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering", second edition, Academic Press, 2005.
3. Richard C. Dorf, Robert H. Bishop, "Modern control systems", Pearson, 2004.

Course Code	**Sensors And Measurements**	L	T	P	C
BM4302		3	0	2	4

COURSE OBJECTIVES:

The students should be made

- To understand the purpose of measurement, the methods of measurements, errors associated with measurements
- To know the principle of transduction, classifications and the characteristics of different transducers
- To learn the different bridges for measurement.
- To know the different display and recording devices.
- To understand various type of biosensors

UNIT I Fundamentals of Measurements **9**

Measurement System – Instrumentation - Classification and Characteristics of Transducers - Static and Dynamic characteristics - Errors in Measurements and their statistical analysis- methods of error analysis,- propagation of errors; uncertainty analysis, Calibration.

UNIT II Displacement, Pressure, Temperature Sensors **9**

Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded strain gage. Capacitive transducer - various arrangements, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, Active type: Thermocouple - characteristics.

UNIT III Photoelectric and Piezo Electric Sensors **9**

Phototube, scintillation counter, photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers. Optical displacement sensors and optical encoders. Piezoelectric active transducer- Equivalent circuit and its characteristics.

UNIT IV Signal Conditioning Circuits and Meters **9**

Functions of signal conditioning circuits, Preamplifiers, Concepts of passive filters, Impedance matching circuits, AC and DC Bridges - wheat stone bridge, Kelvin, Maxwell, Hay, Schering, Q meter, PMMC, MI and dynamometer type instruments - DC potentiometer- Digital voltmeter – Multi meter.

UNIT V Recording Devices and Advanced Sensors **9**

CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Biosensors: transduction mechanism in a biosensor and Classification - Electronic nose.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Measure various electrical parameters with accuracy, precision, resolution
CO2: Select appropriate passive or active transducers for measurement of physical phenomenon
CO3: Select appropriate light sensors for measurement of physical phenomenon
CO4: Use AC and DC bridges for relevant parameter measurement
CO5: Employ multimeter, CRO and different types of recorders for measurement

TEXT BOOKS:

1. A.K.Sawhney, “Electrical & Electronics Measurement and Instrumentation”,10th edition, Dhanpat Rai & Co, New Delhi, 19th Revised edition 2011, Reprint 2014.
2. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015
3. Ernest O Doebelin and Dhanesh N Manik, “Measurement systems, Application and design”, 6th edition, McGraw-Hill, 2012

REFERENCES :

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, 3rd edition,Tata McGraw-Hill, New Delhi, 2014.
2. Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prentice hall of India, New Delhi, 2015.
3. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 1st edition, 2016.

EC4311		3	0	2	4

COURSE OBJECTIVES:

The students should be made

- To understand the structure of basic electronic devices.
- To familiarize the operation and applications of transistor like BJT and FET.
- To explore the characteristics of multistage gain and frequency response.
- To learn the required functionality of positive and negative feedback system
- To learn to know the essentials in design of power supply

UNIT I Semiconductor Devices **9**

Review of BJT, JFET, MOSFET- structure, operation, characteristics with Biasing, UJT, Thyristors, and IGBT - Structure and characteristics.

UNIT II Amplifiers **9**

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT III Multistage Amplifiers and Differential Amplifier **9**

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis)-Introduction to Opamps. Inverting amplifier, Non-inverting Amplifiers.

UNIT IV Feedback Amplifiers and Oscillators **9**

Advantages of negative feedback – voltage/current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts, and Crystal oscillators.

UNIT V Power Supply Design **9**

Power amplifiers- class A-Class B-Class AB-Class C-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis

45 PERIODS

LIST OF EXPERIMENTS

1. Characteristics of PN Junction Diode
2. Zener diode Characteristics & Regulator using Zener diode
3. Common Emitter input-output Characteristics
4. Common Base input-output Characteristics
5. FET Characteristics
6. SCR Characteristics
7. Clipper and Clamper & FWR
8. Oscillator ckts
9. Negative feedback ckts

10. Simulation and PCB design

30 PERIODS LAB
TOTAL: 75 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Analyze the structure and characteristics BJT, FET, MOSFET, UJT, Thyristor and IGBT
CO2: Analyze the performance of various configurations of BJT and MOSFET based amplifier
CO3: Enumerate the characteristics of MOS based cascade and differential amplifier
CO4: Application the operation of various feedback amplifiers and oscillators
CO5: Design and analyze power amplifiers and supply circuits

TEXT BOOKS:

1. David A. Bell, ”Electronic devices and circuits”, Oxford University higher education, 5th edition 2008.
2. Sedra and smith, “Microelectronic circuits”,7th Edition., Oxford University Press, 2017 28
3. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education / PHI, 2008.

REFERENCES:

1. Balbir Kumar, Shail.B.Jain, “Electronic devices and circuits” PHI learning private limited, 2nd edition 2014.
2. Thomas L.Floyd, “Electronic devices” Conventional current version, Pearson prentice hall, 10th Edition, 2017.
3. Donald A Neamen, “Electronic Circuit Analysis and Design” Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, “Electronic devices and circuit theory”, 11th edition, Pearson prentice Hall 2013.
5. Robert B. Northrop, “Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation”, CRC Press, Second edition, 2012.

6.

Course Code	**Signal Processing**	L	T	P	C
EC4312		3	0	2	4

COURSE OBJECTIVES:

The students should be made

- To understand about the continuous time and discrete time signals and systems.

- To learn the analysis of LTI systems using Laplace and Z transform.
- To represent the signal in frequency domain using FFT.
- To gain knowledge about the design of IIR and FIR filters.

UNIT I Fundamentals of Signals and Systems **9**

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II Analysis of LTI Systems **9**

Fourier Series - Fourier Transform and Properties, Analysis of Continuous Time LTI Systems – Z Transform - Properties of ROC– Inverse Z Transform – DTFT - Analysis of Discrete Time LTI Systems

UNIT III Discrete Fourier Transform **9**

DFT and its properties, magnitude and phase representation-Linear Convolution- Correlation-Circular Convolution, Overlap-add and overlap-save methods. FFT - Decimation in Time Algorithm, Decimation in Frequency Algorithm. Use of FFT in Linear Filtering.

UNIT IV Infinite Impulse Response Filters **9**

Analog filters – Butterworth filters, Chebyshev Type I filters (upto 3rd order), Analog Transformation of prototype LPF to BPF /BSF/ HPF. Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z transform method - Realization structures for IIR filters – direct, cascade and parallel forms.

UNIT V Finite Impulse Response Filters and Multirate Signal Processing **9**

Design of linear phase FIR filters - windowing and Frequency sampling methods. Realization structures for FIR filters – Transversal and Linear phase structures, Comparison of FIR and IIR. Introduction to DSP processors. Introduction to Multirate signal Processing – Decimation and Interpolation.

45 PERIODS

LIST OF EXPERIMENTS

1. Construction of signals with different Frequencies.
2. Analyse the stability of a CT System with various inputs.
3. Analyse the stability of a DT System with various inputs.
4. Reconstruct a signal from samples and study the effect of Aliasing.
5. Spectrum Analysis using FFT
6. Filter Design & Analysis.
7. Finite word length effect.
8. Multirate Signal Processing.
9. DSP Processor Implementation. (Linear and Convolution, FFT implementation,
10. DSP Processor (IIR and FIR filters implementation)

30 PERIODS LAB
TOTAL: 75 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: To classify the continuous time and discrete time signals and systems.
CO2: To analyze the signals in both continuous time and discrete time
CO3: To apply DFT for the analysis of digital signals & systems
CO4: To design IIR filter to process real world signals.
CO5: To design FIR filter to process real world signals.

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, Indian Reprint, 2nd Edition, 2015.
2. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson, 4 th Edition, 2014.

REFERENCES:

1. S. Haykin and B. Van Veen, "Signals and Systems", Wiley, 2 nd Edition, 2007
2. B. P. Lathi, "Principles of Linear Systems and Signals", Oxford, 2nd Edition, 2009.
3. Emmanuel Ifeachor, Barrie Jervis, "Digital Signal Processing- A practical approach", Pearson, 2 nd Edition, 2002.
4. M. H. Hayes, "Digital Signal Processing, Schaum's outlines", Tata McGraw Hill, 2nd Edition, 2011.

Course Code	**Object Oriented Programming With Java**	L	T	P	C
CS4311		3	0	2	4

COURSE OBJECTIVES:

- To understand Object Oriented Programming concepts and basics of Java programming language
- To know the principles of packages, inheritance and interfaces.
- To develop a java application with threads and generics classes.
- To define exceptions and use I/O streams.
- To understand the fundamentals of collection framework and JDBC connectivity and implement in small applications.

UNIT I Fundamentals of Java **9**

Overview of Object-Oriented Programming –– Features of Object-Oriented Programming – Java Buzzwords –The Java Programming Environment– Data Types, Variables, constants – Operators – Mathematical Functions and Constants-Conversions between Numeric Types- Casts- Parentheses

and Operator Hierarchy- Enumerated Types-Control flow Statements –Arrays- Programming Structures in Java.

UNIT II Implementation of OOP Concepts **9**

Defining classes in Java – Constructors -Methods -Access specifiers – Static members- Java Doc comments-Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces

UNIT III Exception Handling and Multithreading **9**

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication-Suspending –Resuming, and Stopping Threads –Multithreading.

UNIT IV I/O, Generics, String Handling **9**

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods, String Buffer Class & String Builder class.

UNIT V Collections Framework & Database Connectivity **9**

Collections Framework-Autoboxing -For-Each Style for Loop-Collection Interfaces-Collection Interface-List Interface-Set Interface -Sorted Set Interface-Collection Classes-Array List Class-LinkedList Class-HashSet Class-LinkedHashSet Class-Tree Set Class- Enum Set Class-Accessing a Collection via an Iterator-Using an Iterator-The For-Each Alternative to Iterators-Storing User-Defined Classes in Collections-Working with Maps-The Map Interfaces-The Map Classes-Arrays-Accessing databases using JDBC connectivity – DAO

THEORY:45

PRACTICAL :30

TOTAL NUMBER OF PERIODS INCLUDING LAB: 75

LIST OF EXPERIMENTS:

1. Write a program to demonstrate the use of multidimensional arrays and loping constructs.
2. Write a program to demonstrate the application of String handling functions.
3. Write a program to demonstrate the use of Inheritance.
4. Write a program to demonstrate the application of user-defined packages and sub-packages.
5. Write a program to demonstrate the use of Java Exception handling methods.
6. Write a program to demonstrate the use of threads in Java.
7. Demonstrate with a program the use of File handling methods in Java.
8. Demonstrate the use of Java collection frameworks in reducing application development time.
9. Write a program to register students data using JDBC with MySQL Database.
10. Develop applications to demonstrate the features of generics classes.
11. Develop a mini project for any application using Java concepts.

Lab Requirements: for a batch of 30 students

Operating Systems: Linux / Windows

Front End Tools: Eclipse IDE / Netbeans IDE

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Apply the concepts of classes and objects to solve simple problems
CO2: Develop programs using inheritance, packages and interfaces
CO3: Make use of exception handling mechanisms and multithreaded model to solve real world problems
CO4: Build Java applications with I/O packages, string classes, Collections and generics concepts
CO5: Develop small applications with collection framework elements and manipulate with the SQL database

TEXTBOOKS:

1. Herbert Schildt, "Java: The Complete Reference", 11 th Edition, McGraw Hill Education, New Delhi, 2019
2. Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11 th Edition, Prentice Hall, 2018.

REFERENCES:

1. Paul Deitel Harvey Deitel, Java, How to Program, Prentice Hall; 9th edition, 2019

Course Code	**Core Course Project I**	L	T	P	C
BM4303		0	0	2	1

COURSE OBJECTIVES:

- To provide sufficient hands-on learning experience related to the ideation of design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

CONTENTS

1. Project may be a theoretical analysis, modelling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Project is done based on the knowledge gained from the core courses within the semester based on the completion of required number of credits as per the academic regulations.
3. Can be individual work or a group project, with a maximum of 3 students.
4. In case of group projects, the individual project report of each student should specify the individual contribution to the project
5. Carried out inside or outside the university, in any relevant industry or research institution.
6. Publications in the peer reviewed journals / International Conferences will be an added advantage

MODE OF EVALUATION: Periodic reviews, Presentation, Final oral viva, Poster submission

COURSE OUTCOME:

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

CO1: Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
CO2: Perform literature search and / or patent search in the area of interest.
CO3: Conduct experiments / Design and Analysis / solution iterations and document the results.
CO4: Perform error analysis / benchmarking / costing
CO5: Synthesise the results and arrive at scientific conclusions / products / solution
CO6: Document the results in the form of technical report / presentation

Course Code	**Employability Enhancement Skills – III:**	L	T	P	C
ES4301	**Professional Communication And Teamwork Skills**	0	0	2	1

COURSE OBJECTIVES:

- To familiarize students with various forms of communication.
- To develop effective team communication skills.
- To enhance stakeholder communication skills.
- To cultivate ethical communication practices.
- To explore digital communication tools and trends.

UNIT 1: Introduction to Communication - Verbal Communication Skills: - Written Communication Skills - Nonverbal Communication - Interpersonal Communication

UNIT 2: Characteristics of Effective Teams - Team Building and Group Cohesion - Conflict Resolution - Decision Making in Teams - Cross-Cultural Communication

UNIT 3: Stakeholder Communication - Presentation Skills - Effective Meetings - Feedback and Evaluation

UNIT 4: Professional Codes of Conduct - Integrity in Communication - Addressing Ethical Challenges - Analyzing real-world ethical communication dilemmas

UNIT 5: Digital Communication Tools - Social Media and Networking - Emerging Trends in Communication

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: At the end of the course, students will be able to

CO1: Demonstrate proficiency in various forms of communication.
CO2: Exhibit strong team communication skills.
CO3: Display competence in stakeholder communication.
CO4: Apply ethical communication principles.
CO5: Utilize digital communication tools effectively.

TEXTBOOKS:

1. Sharon J. Gerson and Steven M. Gerson. "Technical Communication: Process and Product", Pearson, 2014
2. Karl A. Smith. “Teamwork and Project Management”, McGraw-Hill Education, 2013
3. Charles E. Harris Jr., Michael S. Pritchard, and Michael J. Rabins. "Engineering Ethics: Concepts and Cases", Cengage Learning, 2012
4. Christoph Meinel and Harald Sack. "Digital Communication: Communication, Multimedia, Security", Springer, 2014

REFERENCES

1. Katherine L. Adams and Gloria J. Galanes. "Communicating in Groups: Applications and Skills", McGraw Hill Education, 2018
2. Lawrence Holpp. "Managing Teams: Strategies for Success", McGraw Hill, 1998.
3. Caroline Whitbeck (ed) "Ethics in Engineering Practice and Research", Cambridge University Press, 2011

SEMESTER IV

Course Code	Biomechatronics	L	T	P	C
BM4402		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Detail the principles of mechanics.
- Discuss the mechanics of physiological systems.
- Illustrate the mechanics of joints.
- Illustrate the mathematical models used in the analysis of biomechanical systems

UNIT I Introduction to Mechanics **9**

Scope of mechanics in medicine, mechanics of bone structure, determination of in-vivo elastic modulus. Bio fluid mechanics, flow properties of blood. Anthropometry.

UNIT II Mechanics of Physiological Systems **9**

Heart valves, power developed by the heart, prosthetic valves. Constitutive equations for soft tissues, dynamics of fluid flow in cardiovascular system and effect of vibration - shear stresses in extra- corporeal circuits.

UNIT III Orthopaedic Mechanics **9**

Mechanical properties of cartilage, diffusion properties of articular cartilage, mechanical properties of bone, Analysis of rigid bodies in equilibrium, Freebody diagrams, Structure of joints kinetics and kinematics of joints, Lubrication of joints.

UNIT IV Mechatronics for Biomechanics **9**

Sensors, actuators and Feedback control, Assistive devices - Design of Assistive Devices - Ergonomics –Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Exoskeleton application

UNIT V Application of Biomechatronics for Limbs **9**

Gait analysis and Motion analysis using video. Prosthetic upper and lower Limbs. Design of wheel chair EEG AND EMG for design of bionic limbs

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the principles of mechanics
CO2: Outline the principles of biofluid dynamics.
CO3: Explain the fundamentals of bio-solid mechanics.
CO4: Apply the knowledge of Mechatronics in building assistive devices.
CO5: computational mathematical modelling applied in biomechanics.

TEXT BOOKS:

1. Y.C. Fung, "Bio-Mechanics- Mechanical Properties of Tissues", Springer-Verlag, 1998.
2. Subrata Pal, "Textbook of Biomechanics", Viva Books Private Limited, 2009.

REFERENCES:

1. Krishna B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers, "Biofluid Mechanics: The Human Circulation", Taylor and Francis, 2007.
2. SherazS. Malik and Shahbaz S. Malik, "Orthopaedic Biomechanics Made Easy", Cambridge University Press, 2015.
3. Jay D. Humphrey, Sherry De Lange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design", Springer Science Business Media, 2004.
4. Shrawan Kumar, "Biomechanics in Ergonomics", Second Edition, CRC Press 2007.
5. Neil J. Mansfeild, "Human Response to Vibration", CRC Press, 2005.
6. Carl J. Payton, "Biomechanical Evaluation of movement in sports and Exercise", 2008

Course Code	**Analog And Digital Communication**	L	T	P	C
EC4411		3	0	2	4

COURSE OBJECTIVES:

The students should be made

- To understand analog and digital communication techniques.
- To Learn data and pulse communication techniques.
- To Be familiarized with source and Error control coding.
- To Gain knowledge on multi-user radio communication.

UNIT I Analog Communication **9**

Introduction to Communication Systems - Modulation - Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation - Comparison of Analog Communication Systems (AM - FM - PM).

UNIT II Pulse and Data Communication **9**

Pulse Communication: Pulse Amplitude Modulation (PAM) - Pulse Time Modulation (PTM) - Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM - PTM - PCM) **Data Communication:** History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Data communication Hardware - serial and parallel interfaces.

UNIT III Digital Communication **9**

Amplitude Shift Keying (ASK) - Frequency Shift Keying (FSK)-Phase Shift Keying (PSK) - BPSK-QPSK - Quadrature Amplitude Modulation (QAM) - 8 QAM - 16 QAM - Bandwidth Efficiency-Comparison of various Digital Communication System (ASK - FSK - PSK - QAM).

UNIT IV Source and Error Control Coding **9**

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, cyclic codes - ARQ Techniques.

UNIT V Multi-User Radio Communication **9**

Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) - Cellular Concept and Frequency Reuse - Channel Assignment and Handover Techniques - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. AM modulation and Demodulation of Signals.
2. FM modulation and Demodulation of Signals.
3. PAM and PCM modulation
4. ASK modulation and Demodulation
5. FSK modulation and Demodulation
6. Error Control Coding Techniques.
7. Simulation study on Communication System
8. Study of CDMA system
9. Study of Satellite system
10. Study of GSM system
11. Study of CDMA system

30 PERIODS LAB

TOTAL: 75 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Apply analog and digital communication techniques.
CO2: Use data and pulse communication techniques.
CO3: Analyse Digital communication techniques
CO4: Analyse Source and Error control coding
CO5: Utilize multi-user radio communication

TEXT BOOKS:

1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009. 83

REFERENCES:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.
4. B. P.Lathi, "Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press, 2007.
5. Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.
6. Martin S.Roden, "Analog and Digital Communication System", 3rd Edition, Prentice Hall of India, 2002.
7. B.Sklar, "Digital Communication Fundamentals and Applications" 2nd Edition Pearson Education 2007

Course Code	**Biomedical Instrumentation**	L	T	P	C
BM4401		3	0	2	5

COURSE OBJECTIVES:

- To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements.
- To understand the characteristics of Bio signals.
- To understand the design of bio amplifiers
- To explain the different techniques used for measurement of non-electrical bio parameters
- To explain the biochemical measurement techniques as applicable for diagnosis and treatment.

UNIT I Electrode Configurations **9**

Bio signals characteristics – Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non-polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.

UNIT II Biosignal Characteristics **9**

Bio signals characteristics – ECG-frequency and amplitude ranges – Einthoven's triangle, standard 12 lead system. EEG - EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG–unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode. ECG, EEG, EMG, ERG, EOG, GSR, PCG.

UNIT III Bioamplifiers **9**

Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference, Electrical Isolation (optical and electrical)

UNIT IV Measurement of Bio Signals **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: Auscultatory methods, oscillometric method, direct methods: electronic manometer, Pressure

amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements

UNIT V Biochemical Measurements **9**

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers, Colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer. Safety of Biomedical Instruments

LIST OF EXPERIMENTS:

1. Design of pre amplifiers to acquire bio signals along with impedance matching circuit using suitable IC's
2. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
3. Design of EMG amplifier
4. Design a suitable circuit to detect QRS complex and measure heart rate
5. Design of frontal EEG amplifier
6. Design of EOG amplifier to detect eye blink
7. Design a right leg driven ECG amplifier.
8. Design and study the characteristics of optical Isolation amplifier
9. Measurement of pulse-rate using Photo transducer.
10. Measurement of pH and conductivity.
11. Measurement of blood pressure using sphygmomanometer.
12. Measurement and recording of peripheral blood flow
13. Design a PCB layout for any bio amplifier using suitable software tool.

THEORY: 45 PERIODS

LAB: 30 PERIODS

TOTAL: 75 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Illustrate the origin and characteristics of various biological
CO2: Gain knowledge on characteristics of bio signals
CO3: Gain knowledge on various amplifiers involved in monitoring and transmission of biosignals.
CO4: Explain the different measurement techniques for non-electrical bio-parameters
CO5: Explain the biochemical measurement techniques as applicable for diagnosis and further treatment

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall of India, New Delhi, 2015.
2. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

REFERENCES:

1. John Enderle, Susan Blanchard, Joseph Bronzino, "Introduction to Biomedical Engineering", second edition, Academic Press, 2005.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

Course Code	**Analog And Digital Integrated Circuits**	L	T	P	C
EC4412		3	0	2	4

COURSE OBJECTIVES:

The students should be made

- To study the basic principles, configuration and practical applications of op-amps.
- To understand the concept of the application of ADC and DAC in real-time systems and phase-locked loops with applications.
- To analyse and design various combinational digital circuits using logic gates
- To analyse and design synchronous and asynchronous sequential circuits

UNIT I Operational Amplifier and Its Application 9

Operational amplifier –ideal characteristics, Performance Parameters, Linear and Nonlinear Circuits and their analysis- voltage follower, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Low pass, High pass filter and band pass filters, Comparator, Multivibrator and Schmitt trigger, Triangular wave generator.

UNIT II Digital to Analog and Analog to Digital Converters & PLL 9

Analog switches, High speed sample and hold circuit and IC's, Types of D/A converter -Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution. A/D converter - Flash, Dual slope, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator, Voltage to Frequency converters. PLL-Closed loop analysis of PLL, Frequency multiplication/ division, FSK demodulator.

UNIT III The Basic Gates and Combinational Logic Circuits 9

Advanced problems using Boolean theorems, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Comparison of Karnaugh map and Tabulation methods. Logic families- TTL, MOS, CMOS, Bi-CMOS - Comparison of Logic families.

UNIT IV Combinational Logic Circuits 9

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, MUX/DEMUX.

UNIT V Sequential Logic Circuits **9**

Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – state minimization, state assignment, circuit implementation Counters, Ripple Counters, Ring Counters. Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In -Serial Out, Parallel In - Parallel Out, Universal Shift Register.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Design and analysis of Inverting, non-inverting amplifier
2. Design and analysis of Integrator and Differentiator
3. Design and analysis of active filters using op-amp
4. Design and analysis of A-stable & Mono-stable multivibrators using Op-amp
5. Design and analysis of Schmitt trigger using operational amplifier
6. Design and implementation of adders and subtractors
7. Design and implementation of code converters using logic gates (i) BCD to excess-3code (ii) Binary to gray
8. Design and implementation of Multiplexers & Demultiplexers.
9. Design and implementation of Encoders and Decoders.
10. Design and implementation of Magnitude Comparators
11. Design and implementation of counters using flip-flops
12. Design and implementation of shift registers.

30 PERIODS LAB

TOTAL: 75 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Design new analogue linear circuits and develop linear IC-based systems.
CO2: Apply the concepts of ADC and DAC in real-time systems and phase-locked loops to different applications.
CO3: Use Boolean algebra, Karnaug Map, and Quine McCluskey methods apply it to digital systems.
CO4: Design various combinational digital circuits using logic gates.
CO5: Design and analysis of synchronous and asynchronous sequential circuits.

TEXT BOOKS:

1. Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, Mc Graw Hill Education, 3rd Edition, 2017
2. John.F.Wakerly, “Digital design principles and practices”, Pearson Education, 5th Edition, 2018

REFERENCES:

1. Taub and Schilling, "Digital Integrated Electronics", Mc Graw Hill, 2017.
2. Charles H.Roth, Jr, "Fundamentals of Logic Design", Jaico Books, 7th Edition, 2013.
3. M. Morris Mano and Michael D.Ciletti, "Digital Design", Pearson, 5th Edition, 2013.
4. S Salivahanan and V S Kanchana Bhaskaran, Linear Integrated Circuits, McGraw Hill Education, 3rd Edition, 2018

Course Code	**Microprocessors And Microcontroller**	L	T	P	C
EC4413		3	1	0	4

COURSE OBJECTIVES:

The students should be made:

- To understand the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To interface microprocessors with supporting chips.
- To study the Architecture of 8051 microcontroller.
- To design a microcontroller based system.

UNIT I The 8086 Microprocessor **9**

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II 8086 System Bus Structure **9**

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III I/O Interfacing **9**

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller

UNIT IV Microcontroller **9**

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming

UNIT V Interfacing Microcontroller **9**

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

List of experiments :

8086 Programs using kits and MASM

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion, decimal arithmetic and Matrix operations.

8051 Experiments using kits and MASM

4. Basic arithmetic and Logical operations
5. Square and Cube program, Find 2‘s complement of a number

Peripherals and Interfacing Experiments (8086 / 8051)

6. Traffic light controller
7. Stepper motor control
8. A/D and D/A interface and Waveform Generation

THEORY:45 PERIODS

LAB :30 PERIODS

TOTAL:75 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

CO1: Understand and execute programs based on 8086 microprocessor.
CO2: System design using microprocessor 8086
CO3: Design Memory Interfacing circuits.
CO4: Design and interface I/O circuits.
CO5: Design and implement 8051 microcontroller-based systems.

TEXT BOOKS:

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085". Penram International Publishing reprint, 6th Edition, 2017.
2. Douglas V. Hall, "Microprocessor and Interfacing, Programming and Hardware", Tata McGraw Hill, Revised 2nd Edition 2006, 11th reprint 2015.

REFERENCES:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2nd Edition, 2008, 12th impression 2018.

2. Krishna Kant, "Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096'', PHI, 2007, 7th Reprint, 2015.
3. Kenneth J. Ayala., "The 8051 Microcontroller, Thompson Delmar Learning'', 3rd Edition, 2012.
4. A.K. Ray, K.M. Bhurchandi, "Advanced Microprocessor and Peripherals'', Tata McGraw-Hill, 2nd Edition, 2010.
5. Barry B. Brey, "The Intel Microprocessors Architecture, Programming and Interfacing'', Pearson Education, 2007, 2nd impression, 2010.

Course Code	Artificial Intelligence And Machine Learning	L	T	P	C
CS4411		3	0	2	4

COURSE OBJECTIVES:

- Study about data analysis.
- Learn Machine learning techniques for reasoning.
- Introduce supervised learning algorithms.
- Study about ensembling and unsupervised learning algorithms.
- Learn the basics of deep learning using neural networks.

UNIT I Data Analysis and Introduction to Python **9**

Bio Statistics, Probabity basics hypothesis testing of exploratory data analysis, cloud essentials: intro to git & github. Basics of python. Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data in Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores.

UNIT II Machine Learning **9**

Types - Supervised and Unsupervised - Parametric and non-parametric models - discrete and continuous distributions - Generative models for discrete data - Gaussian models-Dimension reduction techniques.

UNIT III Supervised Learning **9**

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests

UNIT IV Ensemble Techniques and Unsupervised Learning **9**

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

UNIT V Neural Networks **9**

Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

45 PERIODS

LIST OF EXPERIMENTS

1. Implementation of Uninformed search algorithms (BFS, DFS).
2. Implementation of Informed search algorithms (A*, memory-bounded A*).
3. Implement naïve Bayes models.
4. Implement Bayesian Networks.
5. Build Regression models.
6. Build decision trees and random forests.
7. Build SVM models.
8. Implement ensembling techniques.
9. Implement clustering algorithms.
10. Implement EM for Bayesian networks.
11. Build simple NN models.
12. Build deep learning NN models.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: At the end of this course, the students will be able to:

CO1: Use appropriate for problem solving.
CO2: Apply reasoning under uncertainty.
CO3: Build supervised learning models.
CO4: Build ensembling and unsupervised models.
CO5: Build deep learning neural network models.

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020

REFERENCES:

1. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education,2007.
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008.
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006.
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013 (http://nptel.ac.in/).
5. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

Course Code	**Core Course Project II**	L	T	P	C
BM4403		0	0	2	1

COURSE OBJECTIVES:

- To provide sufficient hands-on learning experience related to the development of design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

CONTENTS

1. Project may be modelling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Project is done based on the knowledge gained from the core courses within the semester based on the completion of required number of credits as per the academic regulations.
3. Can be individual work or a group project, with a maximum of 3 students.
4. In case of group projects, the individual project report of each student should specify the individual contribution to the project
5. Carried out inside or outside the university, in any relevant industry or research institution.
6. Publications in the peer reviewed journals / International Conferences will be an added advantage

MODE OF EVALUATION: Periodic reviews, Presentation, Final oral viva, Poster submission

COURSE OUTCOME: At the end of the course the student will be able to

CO1: Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
CO2: Perform literature search and / or patent search in the area of interest.
CO3: Conduct experiments / Design and Analysis / solution iterations and document the results.
CO4: Perform error analysis / benchmarking / costing
CO5: Synthesise the results and arrive at scientific conclusions / products / solution
CO6: Document the results in the form of technical report / presentation

Course Code	**Employability Enhancement Skills – IV:**	L	T	P	C
ES4401	**Leadership And Project Management Skills**	0	0	2	1

COURSE OBJECTIVES:

- To understand leadership within the context of project management.
- To differentiate between leadership and management roles.
- To learn project initiation processes and setting SMART objectives.
- To build high-performing teams through motivation, empowerment, and effective communication.

- To develop skills in project planning, estimation, resource allocation, risk management, and scheduling.

UNIT 1: Understanding Leadership - Introduction to Project Management - Leadership vs. Management - Project Initiation - Setting SMART Objectives

UNIT 2: Building High-Performing Teams - Motivation Theories - Empowering Team Members - Leadership Communication - Handling Team Conflicts

UNIT 3: Work Breakdown Structure (WBS) - Estimation Techniques - Gantt Charts and Network Diagrams - Resource Allocation - Risk Management

UNIT 4: Leading Project Teams - Monitoring and Controlling Progress - Change Management - Quality Management - Stakeholder Communication

UNIT 5: Project Closure Activities - Lessons Learned - Celebrating Success - Transition Planning

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: At the end of the course, students will be able to

CO1: Apply leadership principles to project management scenarios.
CO2: Distinguish between leadership and management functions in project environments.
CO3: Initiate projects effectively by setting SMART objectives.
CO4: Foster high-performing teams through motivation, empowerment, and conflict resolution.
CO5: Proficiently plan, schedule, and manage project activities, resources, risks, and stakeholder communications.

TEXTBOOKS:

1. Peter G. Northouse. "Leadership: Theory and Practice", SAGE Publications, 2021
2. Patrick Lencioni. "The Five Dysfunctions of a Team: A Leadership Fable", Jossey-Bass, 2011
3. Robert K. Wysocki. "Effective Project Management: Traditional, Agile, Extreme", Wiley, 2019
4. Clifford F. Gray and Erik W. Larson. "Project Management: The Managerial Process", McGraw-Hill Education, 2017
5. Harold Kerzner. "Project Management Case Studies", Wiley, 2008

REFERENCES:

1. Harold Kerzner. "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", 10th edition, Wiley, 2009
2. Gregory P. Shea and Cassie A. Solomon. "Leading Successful Change: 8 Keys to Making Change Work",Gildan Media, LLC, 2013

SEMESTER V

Course Code	Medical Imaging Systems	L	T	P	C
BM4501		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To understand the generation of X-ray and its uses in imaging
- To describe the principle of Computed Tomography.
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging
- To discuss the radiation therapy techniques and radiation safety

UNIT I Medical X-Ray Equipment **9**

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X Ray Tube, the collimator, Bucky Grid, power supply, Cathode and filament currents, Focusing cup, Thermionic emission, Electromagnetic induction, Line focus principle and the heel effect, Causes of x-ray tube failure: Electron arcing/filament burn out, Failure to warm up tube, High temp due to over exposure, x-ray tube rating charts. X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, Cine Angiography, Digital subtraction Angiography. Mammography and Dental x-ray unit.

UNIT II Computed Tomography **9**

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors- Viewing systems - spiral CT scanning – Ultra fast CT scanners. Advantages of computed radiography over film screen radiography: Time, Image quality, Lower patient dose, Differences between conventional imaging equipment and digital imaging equipment: Image plate, Plate readers, Image characteristics, Image reconstruction techniques- back projection and iterative method. Spiral CT, 3D Imaging and its application.

UNIT III Magnetic Resonance Imaging **9**

Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system system magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), and shim coils, Electronic components, fMRI.

UNIT IV Nuclear Medicine Techniques **9**

Nuclear imaging – Anger scintillation camera –Nuclear tomography – single photon emission computer tomography, positron emission tomography – Recent advances. Radionuclide imaging Bone imaging, dynamic renal function, myocardial perfusion. Non imaging techniques hematological measurements, Glomerular filtration rate, volume measurements, clearance measurement, whole -body counting, surface counting

UNIT V Radiation Therapy and Radiation Safety **9**

Radiation therapy – linear accelerator, Telegamma Machine. SRS –SRT,-Recent Techniques in radiation therapy - 3DCRT – IMRT – IGRT and Cyber knife- radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles.

45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

CO1: Describe the working principle of X ray machine and its application.
CO2: Illustrate the principle computed tomography.
CO3: Interpret the technique used for visualizing various sections of the body using magnetic resonance imaging
CO4: Demonstrate the applications of radio nuclide imaging.
CO5: Outline the methods of radiation safety

TEXT BOOKS:

1. Steve Webb, "The Physics of Medical Imaging", Adam Hilger, Philadelpia, 1988 (Units I, II, III & IV).
2. R. Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, WileyLiss, 2002.

REFERENCES:

1. Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine"- Third edition Springer, 2006.
2. B.H.Brown, PV Lawford, R H Small wood, D R Hose, D C Barber, "Medical physics and Biomedical Engineering", - CRC Press, 1999.
3. Myer Kutz, "Standard handbook of Biomedical Engineering and design", McGraw Hill, 2003.
4. P.Ragunathan, "Magnetic Resonance Imaging and Spectroscopy in Medicine Concepts and Techniques", Paperback – Import, 2007

Course Code	**Biomaterials**	L	T	P	C
BM4502		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To have an overview of biomaterial science.
- To describe the principles of compatability design with a case study.
- To explain the interaction and design parameters

- To study about various testing.
- To study about ethical issues and regulation aspects

UNIT I Introduction to Biomaterial Science **9**

Basic properties of biomaterials - Metallic, Ceramic, Polymeric and Composite -Medical fibres and biotextiles – Smart polymers – bioresorbable and bio erodible materials – natural materials, metals and ceramics – physicochemical surface modification. Chemical and biochemical degradation of polymers – degradation of metals and ceramics – calcification of biomaterials.

UNIT II Compatability **9**

Biocompatibility concepts: Introduction to biocompatibility – cell material interaction – types of materials – toxic, inert, bioactive – long term effects of materials within the body – cell response. Biomaterial characterization techniques Fundamental characteristics of implants - biocompatibility, bioactivity, biodegradability. Basics of drug delivery Basics of tissue engineering Rheology.

UNIT III Interactions **9**

Host reactions and their evaluation: Inflammation and foreign body response – adaptive immunity – systemic toxicity and hypersensitivity – blood coagulation and blood materials interactions – device related infections.

UNIT IV Evaluation **9**

Biological testing of biomaterials: Invitro and invivo assessment of tissue compatibility – evaluation of blood materials interaction – microscopy in biomaterials.

UNIT V Regulation **9**

Practical aspects of biomaterials: Bioelectrodes, biomedical sensors and biosensors – sterilization of implants – implant failure – implant retrieval and evaluation – legal aspects, ethical issues and regulation aspects.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Gain adequate knowledge about biomaterial science.
CO2: Get clear idea of compatibility parameters and solutions.
CO3: Have in-depth knowledge about interaction.
CO4: Explain different types testing techniques.
CO5: Access practical issues

TEXT BOOKS:

1. Buddy D Ratner, Allan S Hoffman, "Biomaterials Science – An introduction to materials in Medicine", Elsevier academic press, (2004).
2. John Enderle, Joseph D.Bronzino, Susan M.Blanchard, "Introduction to biomedical Engineering", Elsevier, 2005.

REFERENCES:

1. Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, "Biomaterials: A Nano Approach", CRC Press, 2010.

2. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. "Implant biomaterials: A comprehensive review", World Journal of Clinical Cases, 2015.
3. Biomaterials- Basic Theory with Engineering Applications C.Mauli Agarwal, Joo L.Ong, Mark R. Appleford, Gopinath Mani. Cambrige University Press, New York- 2016.

Course Code	**Bio And E Waste Management**	L	T	P	C
BM4503		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- Understand the hazardous materials used in hospital and its impact on health
- Understand various waste disposal procedures and management.

UNIT I Healthcare Hazard Control and Understanding Accidents **9**

Healthcare Hazard Control : Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation, Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

UNIT II Biomedical Waste Management **9**

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.

UNIT III Hazardous Materials **9**

Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection.

UNIT IV Facility Safety **9**

Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection,

Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.

UNIT V Infection Control, Prevention and Patient Safety **9**

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections, Medication Safety.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Analyse various hazards, accidents and its control
CO2: Design waste disposal procedures for different biowastes
CO3: Categorise different biowastes based on its properties
CO4: Design different safety facility in hospitals
CO5: Propose various regulations and safety norms

TEXT BOOKS:

1. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012)
2. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).

REFERENCES:

1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI – Fourth Edition, 2006
2. V.J. Landrum, "Medical Waste Management and disposal", Elsevier, 1991

Course Code	**Diagnostic And Therapeutic Equipment**	L		T	P	C
BM4504		3		0	2	4

COURSE OBJECTIVES:

The student should be made to:

- Understand the devices for measurement of parameters related to cardiology.
- Illustrate the recording and measurement of EEG
- Demonstrate EMG recording unit and its uses.
- Explain diagnostic and therapeutic devices related to respiratory parameters.
- Understand the various sensory measurements that hold clinical importance.

UNIT I Cardiac Equipment **9**

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter.

UNIT II Neurological Equipment **9**

Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential – Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation. EEG system maintenance and troubleshooting.

UNIT III Muscular and Biomechanical Equipment **9**

Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation. Static Measurement – Load Cell, Pedobarographic. Dynamic Measurement – Velocity, Acceleration, GAIT, Limb position. Hemodialyzer

UNIT IV Respiratory Measurement and Assist System **9**

Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume and vital capacity, measurements of residual volume, Pneumotachometer – Airway resistance measurement, Whole body Plethysmograph, Intra-Alveolar and Thoracic pressure measurements, Apnoea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

UNIT V Sensory Diagnostic Equipment **9**

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer. Application of LASER in sensing and therapy

LIST OF EXPERIMENTS:

1. Measurement of visually and auditory evoked potential.
2. Galvanic skin resistance (GSR) measurement.
3. Measurement of output intensity from shortwave and ultrasonic diathermy.
4. Measurement of various physiological signals using biotelemetry.
5. Electrical safety measurements.
6. Measurement of various physiological signals using biotelemetry.
7. Measurement of stimulation current waveforms used in medical stimulator.
8. Analyze the working of ESU–cutting and coagulation modes.

9. Recording of Audiogram.
10. Study the working of Defibrillator and pacemakers.
11. Study of ECG, EEG and EMG electrodes.
12. Study of ventilators and Ultrasound Scanners.
13. Study of speech signals using speech signal trainer kit.
14. Measurement of Oxygen Saturation and Heart Rate using Pulse-oximeter.
15. Study of heart lung machine model.

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Describe the working and recording setup of all basic cardiac equipment.
CO2: Understand the working and recording of all basic neurological equipment's.
CO3: Discuss the recording of diagnostic and therapeutic equipment's related to EMG.
CO4: Explain about measurements of parameters related to respiratory system.
CO5: Describe the measurement techniques of sensory responses.

THEORY:45 PERIODS

LAB :30 PERIODS

TOTAL: 75 PERIODS

TEXT BOOKS

1. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2012

REFERENCES

1. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008.
2. Khandpur. R.S., "Handbook of Biomedical Instrumentation". Second Edition. Tata McGrawHill Pub. Co.,Ltd. 2003.
3. Antony Y.K.Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008. 4. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

Course Code	**Embedded C And IoMT**	L	T	P	C
BM4505		3	0	2	4

COURSE OBJECTIVES:

The objective of this course is to enable the student to

- Acquire knowledge and understand fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.
- Understand the hardware architecture and features of embedded microcontrollers and peripherals.
- Understand programming aspects of embedded system design.
- Understand IoT architecture and Build simple IoT Systems using embedded target boards.
- Understand IoMT infrastructure for healthcare applications

UNIT Introduction to Embedded System Design **9**

Introduction to embedded processors- Application Areas- Categories of embedded processors Challenges in Embedded System Design, Design Process- Requirements- Specifications Hardware architecture- Software architecture-Introduction to Harvard & Von Neuman architectures CISC & RISC Architectures. CPU Bus- Bus Protocols- Bus Organisation, Memory Devices, and their Characteristics- RAM, EEPROM-Flash Memory- DRAM. BIOS, POST, Device Drivers

UNIT II Peripheral Interfacing **9**

I/O Devices-Timers and Counters- Watchdog Timers, Interrupt Controllers- A/D and D/A, Interfacing- Memory interfacing with a case study- I/O Device Interfacing with case Study Programmed IO-Memory Mapped IO, Interfacing Protocols-SPI, I2C, USB, CAN, Ethernet/WiFi, Bluetooth

UNIT III Embedded System Software Design **9**

Application Software, System Software, Design techniques – State diagrams, sequence diagrams, flowcharts, etc., Model-based system engineering (MBSE), Use of High-Level Languages embedded C / C++ Programming, Integrated Development Environment tools- Editor- Compiler Linker- Automatic Code Generators- Debugger- Board Support Library- Chip Support Library, Analysis and Optimization-Execution Time- Energy & Power.

UNIT IV Design and Development of IOT **9**

Definition and characteristics of IoT, Technical Building blocks of IoT, Communication Technologies, Physical design of IoT - system building blocks - sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino), Benefits and impact of IoMT. Cybersecurity – vulnerability, penetration & encryption technologies

UNIT V Internet of Medical Things **9**

Case studies – Novel Symmetrical Uncertainty Measure (NSUM) Technique for Diabetes Patients, Healthcare Monitoring system through Cyber-physical system, An loT Model for Neuro sensors, AdaBoost with feature selection using loT for somatic mutations evaluation in Cancer, A Fuzzy Based expert System to diagnose Alzheimer's Disease, Secured architecture for loT enabled Personalized Healthcare Systems, Healthcare Application Development in Mobile and Cloud Environments.

List of lab experiments

1. Write Basic and arithmetic Programs Using Embedded C.
2. Write Embedded C program to test interrupt and timers.
3. Develop Real time applications – clock generation, waveform generation, counter using embedded C.
4. Explore different communication methods with IoT devices.
5. To interface LED/Buzzer with platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on / off LED/Buzzer with specified delay.
6. To interface DC/stepper motor using relay with open platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on motor if push button is pressed.
7. Develop simple application – testing infrared sensor – IoT Applications – using open platform/Raspberry Pi.
8. Develop simple application to interface DHT11 sensor with and write a program to display temperature humidity readings in LCD.
9. Develop IoMT Application using open platform/ Aurdino. /Raspberry Pi. and sensors such as temperature, ECG, Pulse etc.

THEORY: 45 PERIODS

LAB:30 PERIODS

TOTAL: 75PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOME: At the end of this course, the student should be able to

CO1: Explain fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.

CO2: Describe the hardware architecture and features of embedded microcontrollers and peripherals.

CO3: Explain software design tools and embedded system design programming phases.

CO4: Describe IoT Architectures and Build simple IoT Systems using embedded target boards.

CO5: Exhibit understanding of IoMT infrastructure for healthcare applications.

TEXT BOOKS:

1. Embedded Systems – A Contemporary Design Tool, James K Peckol, John Weily, 2008, ISBN: 0-444-51616-6.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “loT Fundamentals: Networking Technologies, Protocols and Use Cases for lnternet of Things, Cisco Press, 2017.
3. Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, “lnternet of Things and Personalized Healthcare Systems”, Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019.

REFERENCE BOOKS:

1. Introduction to Embedded Systems, Shibu K V, Tata McGraw Hill Education Private Limited, 2009, ISBN: 10: 0070678790 3.
2. Embedded Software Primer, David E.Simon, Addison Wesley, ISBN-13: 978-0201615692
3. The Intel Microprocessors, Architecture, Programming and Interfacing" Barry B.Brey, 6th Edition, Pearson Education.
4. Arshdeep Bahga, Vijay Madisetti, "lnternet of Things – A hands-on approach", Universities Press, 2015
5. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
6. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.
7. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
8. Michael Margolis, Arduino Cookbook, "Recipes to Begin, Expand, and Enhance Your Projects", OReilly Media, 2nd Edition.

Course Code	**Core Course Project III**	L	T	P	C
BM4506		0	0	2	1

COURSE OBJECTIVES:

- To provide sufficient hands-on learning experience related to the development of design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

CONTENTS

1. Project may be modelling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Project is done based on the knowledge gained from the core courses within the semester based on the completion of required number of credits as per the academic regulations.
3. Can be individual work or a group project, with a maximum of 3 students.
4. In case of group projects, the individual project report of each student should specify the individual contribution to the project
5. Carried out inside or outside the university, in any relevant industry or research institution.
6. Publications in the peer reviewed journals / International Conferences will be an added advantage

MODE OF EVALUATION: Periodic reviews, Presentation, Final oral viva, Poster submission

COURSE OUTCOME: At the end of the course the student will be able to

CO1: Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
CO2: Perform literature search and / or patent search in the area of interest.
CO3: Conduct experiments / Design and Analysis / solution iterations and document the results.

CO4: Perform error analysis / benchmarking / costing
CO5: Synthesise the results and arrive at scientific conclusions / products / solution
CO6: Document the results in the form of technical report / presentation

Course Code	**Employability Enhancement Skills – V: Innovation And Entrepreneurship**	L	T	P	C
ES4501		0	2	0	1

COURSE OBJECTIVES:

- To understand the fundamentals of entrepreneurship and innovation.
- To explore the components of an innovation ecosystem.
- To learn the principles of the Lean Startup methodology and its application.
- To develop skills in identifying entrepreneurial opportunities.
- To cultivate creativity and ideation techniques for innovation

UNIT 1: Understanding Innovation - Entrepreneurship Fundamentals - Innovation Ecosystem - The Lean Startup Methodology - Identifying Opportunities

UNIT 2: Creativity and Ideation Techniques - Market Research and Validation - Customer Discovery - Prototype Development

UNIT 3: Business Model Canvas - Revenue Models - Customer Acquisition and Retention - Pricing Strategies - Scalability and Growth

UNIT 4: Financial Planning - Funding Options - Pitching Investors - Valuation Method - Financial Management

UNIT 5: Go-to-Market Strategy - Building a Team - Scaling Operations - Managing Growth - Exit Strategies

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: At the end of the course, students will be able to

CO1: Demonstrate an understanding of entrepreneurship fundamentals and innovation principles.
CO2: Analyze and navigate innovation ecosystems.
CO3: Apply Lean Startup methodology to validate and iterate business ideas.
CO4: Identify and evaluate entrepreneurial opportunities effectively.
CO5: Generate creative ideas, conduct market research, validate concepts, and develop prototypes for entrepreneurial ventures.

TEXTBOOKS:

1. Eric Ries. "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", Random Housey, 2011
2. Alexander Osterwalder and Yves Pigneur. "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers", Wiley, 2010
3. Karen Berman and Joe Knight. "Financial Intelligence for Entrepreneurs: What You Really Need to Know About the Numbers" Harvard Business Review Press, 2008

REFERENCES:

1. Clayton M. Christensen. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail", Harvard Business Review Press, 2013
2. Steve Blank and Bob Dorf. "The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company" Wiley, 2020
3. Peter Thiel and Blake Masters. "Zero to One: Notes on Startups, or How to Build the Future" Virgin Digital, 2014

SEMESTER VI

Course Code	Healthcare Analytics	L	T	P	C
BM 4601		3	0	0	3

COURSE OBJECTIVES:

- The objective of this course is to enable the student to
- Understand the statistical methods for the design of biomedical research.
- Comprehend the fundamental of mathematical and statistical theory in the application of Healthcare.
- Apply the regression and correlation analyze in the healthcare data.
- Understand the Meta analysis and variance analysis.
- Interpret the results of the investigational methods.

UNIT I Introduction **9**

Introduction, Computers and bio statistical analysis, Introduction to probability, likelihood & odds, distribution variability. Finding the statistical distribution using appropriate software tool like R/ Python.

UNIT II Statistical Parameters **9**

Statistical parameters p-values, computation, level chi square test and distribution and hypothesis testing -single population proportion, difference between two population proportions, single population variance, tests of homogeneity. Testing of statistical parameters using appropriate software R / Python.

UNIT III Regression and Correlation Analysis **9**

Regression model, evaluating the regression equation, correlation model, correlation coefficient. Finding regression, correlation for the data using appropriate software like R / Python.

UNIT IV Analysis of Variance **9**

META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment. Testing the variance using appropriate software tool like R / Python.

UNIT V Case Studies **9**

Epidemical reading and interpreting of epidemical studies, application in community health, Case study on Medical Imaging like MRI, CT. Case study on respiratory data, Case study on ECG data.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Define the new and existing statistical methodology for their research problem.
CO2: Explain p- values for different statistical test.
CO3: Analyze the biomedical research data and able to report the study results.
CO4: Enumerate the Meta analysis and variance analysis.
CO5: Describe problems of human health and disease for the interest of advancing the publics Health.

TEXT BOOKS:

1. Wayne W. Daniel, Biostatistics-A Foundation for Analysis in the Health Sciences, John Wiley Sons Publication, 10th Edition, 2013.
2. Peter Armotage, Geoffrey Berry and J.N.S. Mathews, Statistical methods in Medical Research, Wiley-Blackwell, 4th Edition, 2001.
3. Bernard Rosner. Fundamentals of biostatistics. Nelson Education, 8th Edition 2015 ISBN:978-1-305-26892-0

REFERENCES:

1. Marcello Pagano and Kimberlee Gauvreu, Principles of Biostatistics, Chapman and Hall/CRC, 2ndEdition, 2018.
2. Ronald N Forthofer and EunSul Lee, Introduction to Biostatistics, Academic Press, 1st Edition, 2014.
3. Animesh K. Dutta, Basic Biostatistics and its Applications, New Central Book Agency, 1st Edition, 2006

Course Code	**Medical Image Processing**	L	T	P	C
BM4602		3	0	2	4

COURSE OBJECTIVES:

The students should be made

- Discuss digital image fundamentals.
- Articulate image enhancement and restoration techniques
- Examining image compression Techniques
- Implementing image segmentation Techniques
- Representation and recognition of images.

UNIT I Digital Image Fundamentals **9**

Digital Image Representation – Fundamental steps in Image Processing)– Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - colour models.

UNIT II Image Enhancement **9**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering – Frequency Domain: 2D Fourier Transform – Smoothing and Sharpening frequency domain filters.

UNIT III Image Restoration and Segmentation **9**

Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering. Segmentation: Edge detection Edge Linking and Boundary detection – Region based segmentation- Morphological processing- erosion and dilation

UNIT IV Image Compression and Representation **9**

Compression: Fundamentals – Image Compression models – Error Free Compression – Lossy compression– Image Compression standards.

UNIT V Image Representation and Recognition **9**

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

List of Experiments

1. Display of Gray scale Images.
2. Histogram Equalization.
3. Design of Non-linear Filtering.
4. Determination of Edge detection using Operators.
5. 2-D DFT and DCT.
6. Filtering in frequency domain.
7. Display of colour images.
8. Conversion between colour spaces.
9. DWT of images.
10. Segmentation using watershed transform.

THEORY: 45 PERIODS

LAB:30PERIODS

TOTAL:75 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

CO2: Operate on images using the techniques of smoothing, sharpening and enhancement.

CO3: Understand the restoration concepts and filtering techniques.

CO4: Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

CO5: Comprehend image compression concepts

TEXT BOOKS:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Willliam K Pratt, "Digital Image Processing", John Willey, 2002.
3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.

Course Code	**Medical Informatics**	L	T	P	C
CS4612		3	0	2	4

COURSE OBJECTIVES:

The students should be made:

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study SQL queries and database programming

To learn the techniques of normalization and functional dependencies.

- To understand the fundamental concepts of transaction processing - concurrency control techniques and recovery procedures.
- To have an introductory knowledge about the Storage and Query processing Techniques

UNIT I Introduction **9**

Purpose of Database System – Views of data – Data Models – Database Languages –– Database System Architecture – Database users and Administrator – Entity Relationship model (E-R model) – E-R Diagrams – ER Design Issues-Extended E-R features.

Coding Exercises

Construct an E-R diagram for a car insurance company whose customers own one or more cars each. Each car has associated with it zero to any number of recorded accidents. Each insurance policy covers one or more cars and has one or more premium payments associated with it. Each payment is for particular period of time and has an associated due date and date when the payment was received.

UNIT II Relational Model **9**

Relational Algebra, Domain Relational Calculus, Tuple Relational Calculus, DDL Commands - Create, Drop, Alter, Truncate, Rename, Keys - primary Key, Foreign Key, DML Commands - Select, Insert, Update, Delete, Any, All, In, Exists, Non Exists, Union, Intersection, DCL Commands - Grant, Revoke, TCL Commands –Commit, Rollback, Savepoint, Subqueries - nested, correlated, Joins- Inner, Outer, and Equi, Functions - SUM, COUNT, AVG,MIN,MAX, Clauses - Group By, Having By, Embedded SQL, Dynamic SQL- Creation and Dropping of Views, Creation and Execution of Stored Procedures Cursors and Triggers -Opening, Fetching and Closing, Creation, Insertion, Deletion and Updating

UNIT III Relational Database Design **9**

Functional Dependencies – Non-loss Decomposition – Functional Dependencies – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form- Multi valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT IV Transactions **9**

Transaction Concepts - Transaction Recovery – ACID Properties – System Recovery – Media Recovery – Two Phase Commit - Save Points – SQL Facilities for recovery – Concurrency – Need for Concurrency – Locking Protocols – Two Phase Locking – Intent Locking – Deadlock-Serializability – Recovery Isolation Levels – SQL Facilities for Concurrency

UNIT V Implementation Techniques **9**

Overview of Physical Storage Media – Magnetic Disks – RAID – Tertiary storage – File Organization – Organization of Records in Files - B+ tree Index Files – Static Hashing – Dynamic Hashing –Query Processing Overview – Catalog Information for Cost Estimation – Selection Operation – Sorting – Join Operation – Database Tuning

LIST OF EXPERIMENTS

1. Configure an Electronic Health Record(EHR) system, input patient data, manage user access, and customize templates.
2. Simulate the exchange of patient data between hospitals, analyze interoperability issues, and ensure data security and privacy.
3. Develop or configure a Clinical Decision Support Systems(CDSS), input clinical scenarios, and analyze the recommendations provided by the system.
4. Set up a telemedicine platform, conduct virtual consultations, and evaluate the effectiveness and user satisfaction.
5. Use tools like WEKA or Python libraries to analyze healthcare data, identify patterns, and predict outcomes.
6. Set up a patient monitoring system, collect and analyze real-time patient data, and ensure data accuracy and security.
7. Use Natural Language Processing (NLP) tools to analyze clinical notes, extract key medical terms, and evaluate the accuracy of information extraction.
8. Develop a prototype of a mobile health app, conduct usability testing, and analyze user feedback.
9. Use tools like Hadoop or Spark to process and analyze large healthcare datasets, identify trends, and generate insights.
10. Set up wearable health devices, collect data, and analyze the effectiveness of these devices in monitoring health metrics.

THEORY:45 PERIODS

PRACTICAL:30 PERIODS

TOTAL:75PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Classify the database applications based on size and complexity.
CO2: Implement SQL queries and database programming.
CO3: Normalize the database and identify the functional dependencies.
CO4: Implement the concept of transaction processing, concurrency control and recovery management.
CO5: Process queries to extract data from a database.

TEXTBOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Fifth Edition, Tata McGraw Hill, 2006.
2. C.J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006

REFERENCES:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition, Pearson Addision Wesley, 2007.
2. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003.
3. S.K.Singh, "Database Systems Concepts, Design and Applications", First Edition, Pearson Education, 2006

Course Code	**Hospital Training/Internship**	L	T	P	C
BM4603		0	0	2	1

COURSE OBJECTIVES:

The student should be made to

- Observe medical professionals at work in the wards and the roles of Allied Health Professionals;
- Provide access to healthcare Professionals to get a better understanding of their work;
- Demonstrate patient-care in a hospital setting.

ASSESSMENT:

- Students need to complete training in any leading Multi-speciality hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course in-charges during the session.
- Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

DEPARTMENTS FOR VISIT

1 Cardiology
1 ENT
2 Ophthalmology
3 Orthopaedic and Physiotherapy
4 ICU/CCU
5 Operation Theatre
6 Neurology
7 Nephrology
8 Radiology
9 Nuclear Medicine
10 Pulmonology
11 Urology
12 Obstetrics and Gynaecology
13 Emergency Medicine
14 Biomedical Engineering Department
15 Histo Pathology
16 Biochemistry
17 Paediatric/Neonatal
18 Dental
19 Oncology
20 PAC's
21 Medical Records / Telemetry T

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, the student should be able to:

CO1: Advocate a patient-centred approach in healthcare
CO2: Communicate with other health professionals in a respectful and responsible manner
CO3: Recognize the importance of inter-professional collaboration in healthcare.
CO4: Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs
CO5: Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served.

Course Code	**Core Course Project IV**	L	T	P	C
BM4604		0	0	2	1

COURSE OBJECTIVES:

- To provide sufficient hands-on learning experience related to the development of design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

CONTENTS

1. Project may be modelling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Project is done based on the knowledge gained from the core courses within the semester based on the completion of required number of credits as per the academic regulations.
3. Can be individual work or a group project, with a maximum of 3 students.
4. In case of group projects, the individual project report of each student should specify the individual contribution to the project
5. Carried out inside or outside the university, in any relevant industry or research institution.
6. Publications in the peer reviewed journals / International Conferences will be an added advantage

MODE OF EVALUATION: Periodic reviews, Presentation, Final oral viva, Poster submission

COURSE OUTCOME: At the end of the course the student will be able to

CO1: Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
CO2: Perform literature search and / or patent search in the area of interest.
CO3: Conduct experiments / Design and Analysis / solution iterations and document the results.
CO4: Perform error analysis / benchmarking / costing
CO5: Synthesise the results and arrive at scientific conclusions / products / solution
CO6: Document the results in the form of technical report / presentation

SEMESTER VII

Course Code	Project Phase I	L	T	P	C
BM4701		0	0	18	9

COURSE OBJECTIVES:

- To provide sufficient hands-on learning experience related to the development of design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

CONTENTS

1. Project may be modelling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Project is done based on the knowledge gained from the core courses within the semester based on the completion of required number of credits as per the academic regulations.
3. Can be individual work or a group project, with a maximum of 3 students.
4. In case of group projects, the individual project report of each student should specify the individual contribution to the project
5. Carried out inside or outside the university, in any relevant industry or research institution.
6. Publications in the peer reviewed journals / International Conferences will be an added advantage

MODE OF EVALUATION: Periodic reviews, Presentation, Final oral viva, Poster submission

COURSE OUTCOME: At the end of the course the student will be able to

CO1: Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
CO2: Perform literature search and / or patent search in the area of interest.
CO3: Conduct experiments / Design and Analysis / solution iterations and document the results.
CO4: Perform error analysis / benchmarking / costing
CO5: Synthesise the results and arrive at scientific conclusions / products / solution
CO6: Document the results in the form of technical report / presentation

SEMESTER VIII

Course Code	Project Phase II	L	T	P	C
BM4801		0	0	6	3

COURSE OBJECTIVES:

- To provide sufficient hands-on learning experience related to the development of design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

CONTENTS

1. Project may be modelling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Project is done based on the knowledge gained from the core courses within the semester based on the completion of required number of credits as per the academic regulations.
3. Can be individual work or a group project, with a maximum of 3 students.
4. In case of group projects, the individual project report of each student should specify the individual contribution to the project
5. Carried out inside or outside the university, in any relevant industry or research institution.
6. Publications in the peer reviewed journals / International Conferences will be an added advantage

MODE OF EVALUATION: Periodic reviews, Presentation, Final oral viva, Poster submission

COURSE OUTCOME: At the end of the course the student will be able to

CO1: Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
CO2: Perform literature search and / or patent search in the area of interest.
CO3: Conduct experiments / Design and Analysis / solution iterations and document the results.
CO4: Perform error analysis / benchmarking / costing
CO5: Synthesise the results and arrive at scientific conclusions / products / solution
CO6: Document the results in the form of technical report / presentation

APPENDIX A: PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE COURSE

BIO ENGINEERING	HEALTHCARE MANAGEMENT	BIO MECHANICS AND COMPUTING
Additive manufacturing for Biomedical Engineer	Management for Biomedical Engineering	Biomechanics and Assistive devices
Artificial Organs and Implants	Hospital Planning and Management	Rehabilitation engineering
Genetic and Tissue Engineering	Medical Waste Management	Ergonomics
Biomedical Optics and Photonics	Clinical Engineering and Clean Room Management	Physiological Modelling and Haptics
Biosensor technology	Bio Statistics	Computational Fluid Dynamics
Medical Device Design and Regulation	Medical Innovation and Entrepreneur ship	Computational Modelling and Simulation
Wearable devices	Hospital Automation	Assistive Technology
E-textile production	Advanced health care technology	Quantum computing

INSTRUMENTATION AND COMMUNI CATION	EMBEDDED SYSTEM AND ACQUISITION OF SIGNAL AND IMAGE PROCESSING	DATA ANALYTICS
Advanced Instrumentation Design	Real time operating system	Mathematical fundamentals for machine learning
Bio MEMS	System on chip	Natural language Programming
Medical system Instrumentation	FPGA and VLSI design	Edge computing
Electrical safety and quality assurance	Embedded processor	Deep learning techniques
Electronic systems for cancer diagnosis	Computer vision and advanced Image processing	Generative AI
Telemedicine and communication system	Advanced Signal Processing	Data Exploration and Data visualisation
Wireless Technology	Image retrieval and medical compression techniques	Text and Speech analytics
Cybersecurity	Augmented Reality /Virtual Reality	Robotics in medicine

FULLSTACK DEVELOP MENT
Web Development 5.0
App Development
UI and Ux design
Cloud services Management
Devops
Web Frameworks
Middle Tire Technologies
Web Application security

VERTICAL-I BIOENGINEERING

Course Code	Additive Manufacturing For Biomedical Engineer	L	T	P	C
BM4V11		3	0	0	3

COURSEOBJECTIVES:

The students should be made:

- To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities.
- To be acquainted with vat polymerization and material extrusion processes
- To be familiar with powder bed fusion and binder jetting processes
- To gain knowledge on applications of direct energy deposition, and material jetting processes.
- To impart knowledge on sheet lamination and direct write technologies.

UNIT I Introduction **9**

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain -ASTM/ISO 52900 Classification - Benefits - AM Unique Capabilities - AM File formats: STL, AMF Applications: Building Printing, Bio Printing, Food Printing, Electronics Printing, Automobile, Aerospace, Healthcare. Business Opportunities in AM.

UNIT II Vat Polymerization and Material Extrusion **9**

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Material Extrusion: Fused Deposition Modeling (FDM) - Process-Materials -Applications and Limitations.

UNIT III Powder Bed Fusion and Binder Jetting **9**

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials- Process - Advantages and Applications. Binder Jetting: Three-Dimensional Printing - Materials -Process - Benefits - Limitations -Applications.

UNIT IV Material Jetting and Directed Energy Deposition **9**

Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process - Material Delivery - Materials - Benefits -Applications.

UNIT V Sheet Lamination and Direct Write Technology **9**

Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation. Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.
CO3: Elaborate the process and applications of powder bed fusion and binder jetting.
CO4: Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.
CO5: Acquire knowledge on sheet lamination and direct write technology.

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1

REFERENCES:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.

Course Code	**Artificial Organs And Implants**	L	T	P	C
BM4V12		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To have an overview of artificial organ and transplant.
- To describe the principles of implant design with a case study.
- To explain the implant design parameters and solution in use.
- To study about various blood interfacing implants.
- To study about soft tissue and hard tissue replacement.

UNIT I Artificial Organ and Transplants **9**

Open and close loop systems, modeling and block diagrams, block diagram and signal flow graph representation of systems, reduction of block diagram and signal flow graph, introduction to physiological control systems-illustration, difference between engineering and physiological control systems.

UNIT II Principles of Implant Design **9**

Step and impulse responses of first order and second order systems, time domain specifications of first and second order systems, steady state error constants Definition of stability, Routh-Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability.

Unit III Implant Design Parameters and Its Solution **9**

Frequency domain specifications - Polar plots, Bode plots, Nyquist plot, Nyquist stability criterion, closed loop stability, Constant M and N circles, Nichol's chart

UNIT IV Blood Interfacing Implants **9**

Distributed parameter versus lumped parameter models, Model development of Cardiovascular system- Heart model-circulatory model, Pulmonary mechanics- Lung tissue visco-elastance-chest wall- airways, Interaction of Pulmonary and Cardiovascular models, Static analysis of physiological systems – Regulation of cardiac output, Regulation of ventilation.

UNIT V Implantable Medical Devices and Organs **9**

Simple models of muscle stretch reflex action, Study of steady state analysis of muscle stretch reflex action, Study of transient response analysis of neuromuscular reflex model action, Study of frequency response of circulatory control model, Stability analysis of Pupillary light reflex.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Gain adequate knowledge about artificial organs and transplants.
CO2: Get clear idea about implant design and its parameters and solutions.
CO3: Have in-depth knowledge about blood interfacing implants.
CO4: Explain different types of soft tissue replacement and hard tissue replacement.
CO5: Access compatability and functioning of artificial organs inside the living system

TEXT BOOKS:

1. Kopff W.J, Artificial Organs, John Wiley and sons, New York, 1st edition, 1976.

REFERENCES:

1. J D Bronzino, Biomedical Engineering handbook Volume II, (CRC Press / IEEE Press), 2000.
2. R S Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill,2003

3. Yannas, I. V, "Tissue and Organ Regeneration in Adults", New NY: Springer, 2001. ISBN:9780387952147
4. John Enderle, Joseph D. Bronzino, Susan M.Blanchard, "Introduction to biomedical Engineering", Elsevier, 2005.

Course Code	Genetic And Tissue Engineering	L	T	P	C
BM4V13		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To discuss the gene cloning methods and the tools.
- To understanding the techniques involved in gene cloning and genome analysis
- To explain the heterologous expression of cloned genes in different hosts.
- To understanding the interaction of biological molecules.
- To understand application of tissue engineering.

UNIT I Basics of Recombinant DNA Technology **9**

Manipulation of DNA – Restriction and Modification enzymes - Design of linkers and adaptors - Characteristics of cloning and expression vectors - Introduction of recombinant DNA in to host cells and selection methods

UNIT II DNA Libraries **9**

Construction of genomic and cDNA libraries, Artificial chromosomes – Bacteria, Yeast - Chromosomal walking.

UNIT III Sequencing and Amplification of DNA **9**

Frequency domain specifications - Polar plots, Bode plots, Nyquist plot, Nyquist stability criterion, closed loop stability, Constant M and N circles, Nichol's chart

UNIT IV Blood Interfacing Implants **9**

Introduction to Tissue Engineering - Objectives of Tissue Engineering - Basic definitions - Structure and organization of Tissues – Development of Tissue – Tissue exchange and diffusion of simple metabolites – Tissue Equivalent - Wound Healing Process - Biocompatibility and toxicity assessment.

UNIT V Tissue Engineering Application **9**

Synthetic components – Artificial organs – Joints and dental prostheses - Connective Tissue Engineering – Cardiovascular Tissue Engineering- Neural Tissue Engineering - Cell and Drug Delivery systems.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Would be aware of how to clone commercially important genes.
CO2: The students would be aware of how to produce the commercially important recombinant proteins
CO3: Will be familiarized with gene and genome sequencing techniques
CO4: Understand the basic concepts of tissue engineering
CO5: Acquire ability to function on multi-disciplinary teams

TEXT BOOKS:

1. Old RW, Primrose SB, "Principles of Gene Manipulation, An Introduction to Genetic Engineering", Blackwell Science Publications, 1993

REFERENCES:

1. Gary E. Wnek, Gary L Browlin, "Encyclopedia of Biomaterials and Biomedical Engineering", Marcel Dekker Inc, New York, 2008
2. R. Lanza, Anthony Atala (Eds), "Essential of Stem Cell Biology", Academic Press, USA, 2013
3. Isil Aksan Kurnaz, "Techniques in Genetic Engineering", CRC Press, 2015

Course Code	**Biomedical Optics and Biophotonics**	L	T	P	C
BM4V14		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To acquire knowledge about the physical properties of light and optical properties of tissue.
- To learn the design and working principle of various optical components.
- To understand the principles and applications of optical biosensors.
- To understand the engineering and practical applications of optical related to diagnostic and surgical applications.
- To understand the phenomenon of laser tissue interaction and practical application of optical related to therapeutic equipments.

UNIT I Optical Properties **9**

Basic principles of light - Reflection - Refraction - Absorption - Polarization - Interference - Coherence, Basic laws of light - Beer Lambert law - Snell's law, Optical properties of tissues - Absorption - Scattering - Anisotropy.

UNIT II Optical Instrumentation **9**

Working principle of light sources - Lasers - LEDs, Working principle of optical detectors - Photodiode - Spectrometer- CMOS and CCD cameras - Lens - Optical filters - Optical fibers..

UNIT III Optical Biosensors **9**

Principles of Optical biosensing - Immobilization of bio-recognition elements, Types of optical biosensor - Fiber optic - Planar waveguide - Evanescent - Interferometric - Surface plasmon resonance - Advantages and disadvantages - Applications.

UNIT IV Applications of Lasers **9**

Diagnostic - Optical coherence tomography, Fluorescence, Raman, Photo acoustic tomography, Laser induced breakdown spectroscopy (LIBS), Hyper spectral imaging. Surgical - Lasers in dentistry, Dermatology, Ophthalmology.

UNIT V Laser Tissue Interaction **9**

Laser tissue interactions via photochemical, Photo thermal, Photomechanical techniques, Photodynamic therapy (PDT) - Oncological and non-ontological applications, Low level laser therapy (LLLT) – bio stimulation applications.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Explain the various physical properties of light and optical properties of tissues.
CO2: Design analysis-by-synthesis model for speech perception..
CO3: Discuss the various applications of biosensors in medicine
CO4: Summarize the diagnostic and surgical applications of lasers in medicine
CO5: Explain the laser tissue interaction and various therapeutic applications of lasers.

TEXT BOOKS:

1. Taun vo dinh, 'biomedical photonics'-handbook, CRC press, Bacaraton,2014
2. Jurgen Popp, Valery V. Tuchin, Arthur Chiou and Stefen Heinemann, handbook of biophotonics, Vol 2: Photonics for Healthcare, John Wiley and Sons, 1st Edition, 2011.

REFERENCES:

1. Markolf H. Niemz, "Laser-Tissue Interaction Fundamentals and Applications" Springer, 2007.
2. Splinter R and Hooper B. A., "An Introduction to Biomedical Optics", Taylor and Francis, 2006.
3. Mark E. Brezinski, "Optical Coherence Tomography: Principles and Applications", Academic Press, 2006.

4. Paras N. Prasad, "Introduction to Biophotonics", A. John Wiley and sons, Inc. Publications, 2003.

Course Code	Biosensors Technology	L	T	P	C
BM4V15		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- Learn the fundamental concept of bio specific interaction is used for various applications.
- Understand the methods of metabolic sensors
- Learn the basic concepts of general principles of sampling and manipulation of data generated by biosensors.
- Study the various types of analytical methods
- Learn and recognize different types of transducers, and their application in biosensor design

UNIT I Fundamentals of Biosensor **9**

Biosensors as functional analogs of chemoreceptors, structure and function of transducers, qualitative and quantitative sensors, sensor parameters, transduction methods-optical, calorimetric, electrochemical and piezoelectric sensors Supports and support modifications-synthetic polymers, carbon material supports, metal supports, bifunctional crosslinkers.

UNIT II Metabolic Sensors **9**

Methods of enzyme immobilization-adsorption, gel entrapment, covalent coupling, crosslinking immobilization effects in biosensors, characterisation of immobilized enzymes in biosensors, effectiveness factor, enzyme loading test, Metabolic sensors-glucose, ascorbic acid, lactate sensors, determination of alcohols, sensors for phenols and amines, coupled enzyme reactors, sequence electrodes for nucleic acid , enzyme sensor for inhibitors.

UNIT III Affinity Sensors and Reagentless Sensors **9**

Affinity sensors based on small ligands, immunosensors, immunoassay-RIA, ELISA and TELISA, piezoelectric immunosensors, optical immunosensors, electrochemical immunoassay, Biocompatibility of sensors, biomimetic sensors, bioconjugated silica nanoparticles for bioanalysis

UNIT IV Novel Biosensors **9**

Surface dielectric enhancement- gold nanoparticles enhanced surface plasmon resonance, magnetic biosensors and biochips, quantum dot based biosensors, DNA and protein conformational changes, optical and magnetic sensors, micro and nanocantilevers, electrochemical QCM, MEMS, PCR microchamber array chip system, Detection of target DNA on a single chip.

UNIT V Applications of Biosensors **9**

Biosensors and diabetes management, Microfabricated biosensors and point-of-care diagnostics systems, Noninvasive biosensors in clinical analysis; Surface plasmon resonance and evanescent wave biosensors, Biosensor in cancer and HIV early diagnosis

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Describe how bio specific interaction is used for various applications
CO2: Compare different techniques with emphasis on selectivity and sensitivity.
CO3: Demonstrate knowledge of the general principles of sampling and manipulation of data generated by biosensors.
CO4: Apply the knowledge to identify the various types of analytical methods
CO5: Design a system component or process to meet desired needs within realistic constraints

TEXT BOOKS:

1. Douglas A, "Principles of Instrumental Analysis", Skoog Brooks Cole publisher, 6th Edition 2006.
2. Keith Wilson & John Walker, "Practical Biochemistry – Principles and Techniques", Oxford University Press, 7th Edition, 2010

REFERENCES:

1. Trevor Palmer, "Understanding Enzymes", Published by Ellis Horwood LTD, 4th Edition, 1995.
2. Harvey Lodish W. H, "Molecular Cell Biology", Freeman publisher 7th Edition, 2012.
3. G. Louis Hornyak, John J. Moore, Harry F. Tibbals and Joydeep Dutta, "Fundamentals of Nanotechnology", CRC press, 1st Edition, 2008.
4. Gabor L. Hornyak, Joydeep Dutta, H.F. Tibbals, Anil Rao, "Introduction to NanoScience", CRC Press, 2008

Course Code	**Medical Device Design And Regulations**	L	T	P	C
BM4V16		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- Introduce the Medical device standards and requirements.
- Illustrate the design procedure of medical devices.
- Outline the quality assessment in design.
- Describe about the design realization.
- Understand the validation and verification of various medical devices

UNIT I Medical Device Regulations **9**

History of medical device regulation, regulatory affairs professional's roles, required competencies, medical device classification: scope, definitions, main classifications, Risk based classification, practical examples, labeling of medical devices: definition, elements, risk management, clinical evaluation and labeling, language level and intended users.

UNIT II Needs Finding and Concept Generation **9**

Strategic Focus – observation and problem identification – Need statement development. Ideation and Brainstorming – concept screening, concept selection: intellectual property basics – reimbursement basics – business models – prototyping – final concept selection. Safety and Risk Management - ools, Documents and Deliverables.

UNIT III Medical Devices Standards and Requirements **9**

FDA, Medical devices classification, Medical Devices Directive Process – Harmonized Standards, ISO13485, ISO 14971, IEC60601-1, IEC 62304. Reliability, Concept of failure, Product Design and Development Process.

UNIT IV Design, Testing and Validation **9**

Hardware Design, Hardware Risk Analysis, Design and Project Metrics, Design for Six Sigma, Software Design, Software Coding, Software Risk Analysis, Software Metrics. Basis and Types of Testing, Hardware Verification and Data Analysis, Software Verification and Data Analysis.

UNIT V Design Transfer and Manufacturing **9**

Transfer to Manufacturing, Hardware Manufacturing, Software Manufacturing, Configuration Management, Intellectual Property-Copy Rights-Trademarks-Trade Secrets. Case Study.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Define the medical devices standards and requirements.
CO2: Summarise the concept of medical device development.
CO3: Recall the engineering design and project metrics.
CO4: Demonstrate the testing and validation of medical equipment.
CO5: Interpret the various design transfer and manufacturing methods.

TEXT BOOKS:

1. Zenios, Makower and Yock, —Biodesign – The process of innovating medical technologies||, Cambridge University Press, 2009
2. Theodore R. Kucklick, The Medical Device R&D Handbook, Second Edition, CRC Press, 2012
3. Peter Ogrodnik, Medical Device Design Innovation from Concept to Market, Elsevier, 2013

REFERENCES:

1. Richard C. Fries and Marcel Dekker AG, Handbook of Medical Device Design,2nd edition, 2005.
2. Gail Baura, Medical Device Technologies: A Systems Based Overview Using Engineering, Elsevier science, 2012.
3. Matthew Bret Weinger, Michael E. Wiklund, Daryle Jean Gardner-Bonneau 'Handbook of Human Factors in Medical Device Design', CRC press,2010.
4. Jagdish Chaturvedi, Inventing medical devices: A perspective from India, Create Space Independent Publishing Platform, 1st edition, 2015.

Course Code	**Wearable Devices**	L	T	P	C
BM4V17		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I Introduction to Wearable Systems and Sensors **9**

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

UNIT II Signal Processing and Energy Harvesting for Wearable Devices **9**

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles

UNIT III Wireless Health Systems **9**

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges – System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT IV Smart Textile **9**

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study smart fabric for monitoring biological parameters - ECG, respiration

UNIT V Applications of Wearable Systems **9**

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon successful completion of the course, students will be able to

CO1: Describe the concepts of wearable system
CO2: Explain the energy harvestings in wearable device
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile.
CO5: Compare the various wearable devices in healthcare system

TEXT BOOKS

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013.

REFERENCES

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

Course Code	**E-Textile Production**	L	T	P	C
BM4V18		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To learn about the basics of fibre forming,
- To yarn production, fabric formation,
- Chemical processing of fabrics and
- Garment manufacturing

UNIT I Basics of Fibre Science and Spinning **9**

Definition of fibre, classification of textile fibers; polymer and polymerization; fibre production principles – wet spinning, dry spinning, melt spinning, gel spinning, dope spinning; characteristics of cotton, viscose, wool, silk, polyester, nylon, polypropylene; sequence of machineries in short staple yarn spinning from ginning to cone winding and their objectives.

UNIT II Basics of Fabric Production **9**

Woven fabric – warp, weft, weaving, path of warp; looms – classification, handloom and its parts, powerloom, automatic looms, shuttleless looms, special type of looms; preparatory machines for weaving process and their objectives; basic weaving mechanism - primary, secondary and auxiliary mechanisms; knitting – classification, principle, types of fabrics; nonwoven process – classification, principle, types of fabrics.

UNIT III Basics of Chemical Processing **9**

Objectives of the processes - singeing, desizing, scouring, bleaching, mercerization; dyeing classification of dyes, types of dyeing techniques; printing –types and styles of printing; finishing treatments – chemical and mechanical finishing.

UNIT IV Electronic Textile Material **9**

Conductive fabrics and threads, Insulating materials, Sensors and actuators for e-textiles, Power sources for wearable electronics.

UNIT V Sewing Techniques for E Textiles **9**

Basic sewing skills for electronic textiles, Conductive thread techniques, Connection methods for components, Fabricating soft circuits.

TOTAL 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon successful completion of the course, students will be able to

CO1: Describe the concepts of wearable system
CO2: Explain the energy harvestings in wearable device
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile.
CO5: Compare the various wearable devices in healthcare system

TEXT BOOKS:

1. Hornberer M., Eberle H., Kilgus R., Ring W. and Hermeling H., "Clothing Technology: From Fibre to Fabric", Europa Lehrmittel Verlag, 2008, ISBN: 3808562250 / ISBN: 978-3808562253.
2. Wynne A., "Motivate Series-Textiles", Maxmillan Publications, London, 1997.
3. Carr H. and Latham B., "The Technology of Clothing Manufacture" Backwell Science, U.K., 1994, ISBN: 0632037482 / ISBN:13: 9780632037483

REFERENCES:

1. Banerjee N. N., "Weaving Mechanism", Textile Book House, ISBN: B001A1S41A, 1986.
2. Booth J. E., "Textile Mathematics Volume 3", The Textile Institute, Manchester, 1977, ISBN: 090073924X.
3. Marks R. and Robinson T. C., "Principles of Weaving", The Textile Institute, Manchester, 1989, ISBN: 0900739258.

VERTICAL 2 -HEALTHCARE MANAGEMENT

Course Code	Management for Biomedical Engineer	L	T	P	C
BM4V21		3	0	0	3

COURSEOBJECTIVES:

The students should be made:

- To understand the importance of patient safety against electrical hazards.
- To explain the patient safety laws and regulations
- To understand the standards and testing of patient
- To know the patient safety specialities in clinical
- To know about the health care organization.

UNIT I Effects of Electricity **9**

Physiological effects of electricity - important susceptibility parameters - microshock macro shock hazards - patients electrical environment - isolated power system - conductive surfaces

UNIT II Patient Safety Laws and Regulations **9**

Mandatory Reporting systems. Anatomy of a patient safety Law: Compliance Tips, Federal patient safety legislation Initiatives, Medical Device Reporting, Clinical trials and Adverse-Event 116 Reporting, Patient safety goals and standards, The Quality Assessment and performance Improvement rule.

UNIT III Standards and Testing **9**

Guidelines and safety practices to improve patient safety, Electrical safety codes and standards - IEC 60601-12005 standard, Basic Approaches to protection against shock, protection equipment design, Electrical safety analyser - Testing the electric system.

UNIT IV Patient Safety in Main Clinical Specialities **9**

Intensive care and Anesthesiology, safety surgery save lives, Emergency department clinical risk, Obstetric safety patient, Patient safety in internal medicine, Patient safety in Radiology.

UNIT V Medical Ethics Management **9**

Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor And Society, Case Studies.

TOTAL 45PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Outline the importance of patient safety against electrical hazards
CO2: Brief out the patient safety laws and regulations
CO3: Explain the standards and testing of patient
CO4: Understand the concept of the patient safety specialities in clinical
CO5: Know about various health care organization

TEXT BOOKS:

1. John G.Webster, "Medical Instrumentation Application and design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
2. Liam Donaldson, Walter Ricciardi, "Textbook of patient safety and clinical Risk management", Springer. 3. Fay A. Rozovsky, James R. Woods, Jr, " The Handbook of Patient Safety Compliance", 2016

REFERENCES:

1. Fay A. Rozovsky, James R. Woods, Jr, " The Handbook of Patient Safety Compliance", 2016
2. Alastair Campbell, "Bioethics: The Basics" 2nd edition, 2017 by Routledge

Course Code	**Hospital Planning And Management**	L	T	P	C
BM4V22		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- The student should be made to understand the principles, practices and areas of application in Hospital management.

UNIT I Overview of Hospital Administration **9**

Distinction between Hospital and Industry, Challenges in Hospital Administration –Hospital Planning – Equipment Planning- AMC – Functional Planning - Current Issues in Hospital Management - Telemedicine - Bio-Medical Waste Management

UNIT II Human Resource Management in Hospital **9**

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT III Marketing Research & Amp; Consumer Behaviour **9**

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer behaviour - Model of consumer behaviour - Types of buying decision behaviour - The buyer decision process - Model of business buyer behaviour - Major types of buying situations - global marketing in the medical sector - WTO and its implications.

UNIT IV Hospital Information Systems; Supportive Services **9**

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services.

UNIT V Quality and Safety Aspects in Hospital **9**

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – ISO 13485, Environment Management Systems. NABA, JCI, NABL, NABH. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care - Medical Audit– Hazard and Safety in a hospital Setup.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Explain the principles, practices and areas of application in Hospital Management.
CO2**:** Understand the biomedical waste disposal concept.
CO3: Explain the importance of supportive services.
CO4: Comprehend the quality aspect specified by the international standards.
CO5: Knowledge on Hospital safety.

TEXT BOOKS:

1. R.C. Goyal, “Hospital Administration and Human Resource Management”, PHI–4th Edition, 2006.
2. G.D. Kunders, “Hospitals – Facilities Planning and Management”, TMH, New Delhi – 5th edition Reprint 2007.
3. Cesar A. Caceres and Albert Zara, “The Practice of Clinical Engineering”, Academic Press, New York, 1977

REFERENCE:

1. Peter Berman, “Health Sector Reform in Developing Countries”, Harvard University Press, 1995.

2. Norman Metzger, “Handbook of Health Care Human Resources Management”, Aspen Publication Inc. Rockville, Maryland, USA, 2nd Edition 1990.
3. Arnold D. Kalcizony & Stephen M.Shortell, “Health Care Management”, 6th Edition, 2011.
4. Blane, David, Brunner, Eric , “Health and Social organization: Towards a health policy for the 21st century”, Calrendon Press, 1994

Course Code	**Medical Waste Management**	L	T	P	C
BM4V23		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Understand the hazardous materials used in hospital and its impact on health
- Understand various waste disposal procedures and management.

UNIT I Healthcare Hazard Control and Understanding Accidents **9**

Healthcare Hazard Control : Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation, Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers’ Compensation, Orientation, Education, and Training

UNIT II Biomedical Waste Management **9**

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.

UNIT III Hazardous Materials **9**

Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection.

UNIT IV Facility Safety **9**

Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety

UNIT V Infection Control, Prevention and Patient Safety **9**

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections, Medication Safety.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Analyse of various hazards, accidents and its control
CO2: Design waste disposal procedures for different biowastes
CO3: Categorise different biowastes based on its properties
CO4: Design different safety facility in hospitals
CO5: Propose various regulations and safety norms

TEXT BOOKS:

1. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012)
2. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).

REFERENCE:

1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI – Fourth Edition, 2006
2. V.J. Landrum, "Medical Waste Management and disposal", Elsevier, 1991

Course Code	**Clinical Engineering And Clean Room**	L	T	P	C
BM4V24		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- This course will provide a basic understanding of the clinical engineering profession, qualifications, roles, activities, and expectations.

- This course will enhance students to practice medical equipment and analyze challenges with their healthcare technology.
- This course will engage the students to work as a team to address problems and errors in medical devices.
- This course will help students to design better medical devices with computerized approaches.
- This course will expose students to explore the Health Technology Management systems with medical devices and supportive services with advanced application.

UNIT I Introduction **9**

Clinical engineering: Definition, Evolution, Role, Responsibilities, Functional status, History of clinical engineering and Technology in Health Care System, Enhancing patient safety.

UNIT II Medical Technology Management Practices **9**

Strategic Medical Technology Planning, Scope, Clinical necessity operational support, strategic planning process – Technology assessment: Technology audit, Budget strategies, Prerequist for medical technology assessment – Management Practice for Medical Equipment – Device evaluation, Risk reduction, Asset management, ESHTA.

UNIT III Essential Health Care Technology Package (EHTP) **9**

Introduction – Health care technology management – Package development: Methodology, Logical framework, Implementation, Information promotion and dissemination – EHTP Justification – EHTP matrix – EHTP advantages – Impact Analysis.

UNIT IV Clinical Engineering Program Indicator **9**

Clinical engineering: program services, Program database – Clinical Engineering Program management, Program indicator, Managing clinical engineering performance using program indicators – Indicator management process.

UNIT V Advanced Technology for Patient Safety **9**

Factors Contributing to Medical Errors: Heath Care Reimbursement, Health Care Failure Mode And Effect Analysis (HFMEA), Patient Safety Best Practices Model: Bar coding, Computerized Physician Order Entry (CPOE), and Clinical data repositories – Process analysis, Methodology. Computerized medical equipment management systems.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: State the role of clinical engineers and discuss the basic concepts of medical and healthcare technology

CO2: Give the program and framework to recognize the errors of medical equipment

CO3: State the issues or errors in patient safety and formulate patient safety package system
CO4: Define the problem precisely and examine the possible issues using program indicators.
CO5: Demonstrate computer based equipment with automated system by using CPOE method. to get adequate knowledge in Design transfer and IPR

TEXT BOOKS:

1. Ernesto Iadanza, Joseph Dyro, “Clinical Engineering Handbook”, Elsevier Academic Press,2014
2. Robert Miniati, “Clinical Engineering from Devices to Systems”, Academic Press, 23-Dec2015 - Technology Engineering.

REFERENCES:

1.Ladanza, E., "Clinical Engineering: A Handbook for Clinical and Biomedical Engineers,". 2019, Academic Press.
2. Dyro, J. F. , "Clinical Engineering Handbook," 2004, Academic Press.
3. Saltzman, W. M., "Biomedical Engineering: Bridging Medicine and Technology," 2019, Cambridge University Press

Course Code	**Biostatistics**	L	T	P	C
BM4V25		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Understand the statistical methods for the data.
- Comprehend the fundamental of mathematical and statistical theory in the application of biomedical field.
- Apply the regression and correlation analyze in the physiological data.
- Understand the source of Medical data
- Understand the Visual analytics of Healthcare data..

UNIT I Introduction **9**

Introduction, Some basic concepts, Measurement and Measurement Scales, Simple random sample, Computers and medical data analysis, Introduction to probability, likelihood & odds, distribution variability.

UNIT II Statistical Parameters **9**

Statistical parameters p-values, computation, level chi square test and distribution and hypothesis testing - single population proportion, difference between two population proportions, single population variance, ratio of two population variances and tests of goodness of fit, tests of independence, tests of homogeneity.

UNIT III Regression and Correlation Analysis **9**

Introduction, regression model, sample regression equation, evaluating the regression equation, 128 using the regression equation, correlation model, correlation coefficient.

UNIT IV Interpreting Data **9**

Interpreting life tables clinical trials, epidemical reading and interpreting of epidemical studies, application in community health.

UNIT V Analysis of Variance **9**

META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Define the new and existing statistical methodology for their research problem.
CO2: Explain p- values for different statistical tests.
CO3: Analyze the biomedical research data and be able to report the study results.
CO4: Describe the various sources of medical data
CO5: Demonstrate the visual analytical procedure of Medical Data.CO5: Propose various regulations and safety norms

TEXT BOOKS:

1. Wayne W. Daniel, Biostatistics-A Foundation for Analysis in the Health Sciences, John Wiley; Sons Publication, 10th Edition, 2013.
2. Peter Armotage, Geoffrey Berry and J.N.S.Mathews, Statistical methods in Medical Research, Wiley-Blackwell, 4th Edition, 2001.
3. Bernard Rosner. Fundamentals of biostatistics. Nelson Education, 8th Edition 2015 ISBN: 978-1-305-26892-0
4. Editors: Chandan K. Reddy, Charu C. Agarwal, Healthcare Data Analytics, CRC Press,

REFERENCE:

1. Marcello Pagano and Kimberlee Gauvreu, Principles of Biostatistics, Chapman and Hall/CRC, 2nd Edition, 2018.
2. Ronald N Forthofer and EunSul Lee, Introduction to Biostatistics, Academic Press, 1st Edition, 2014.
3. Animesh K. Dutta, Basic Biostatistics and its Applications, New Central Book Agency, 1st Edition, 2006.

BM4V26		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To learn fundamentals of entrepreneurship
- To apply the methods of entrepreneurship in medical field
- To evaluate the medical devices and market trends

UNIT I Creativity, Innovation and IPR **9**

The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. Patents – Copyright – Trademark Geographical indications – Ethical and social responsibility and challenges.

UNIT II Scope for Biomedical Engineering Entrepreneurship **9**

Definition– Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs. Fundamentals and models, Advancements in biomedical field, Supporting societies and professional activities. Impact of innovation in medical devices. Case study..

UNIT III New Venture **9**

Developing an Effective Business Model: The Importance of a Business Model – Starting a small scale industry - Components of an Effective Business Model. Assessing the venture, establish venture invention, market research, presenting the business plan. Forms of Business Organization: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. Case study.

UNIT IV Financing the New Venture and Globalization **9**

Evaluating Various options and future investments – Medical Device entrepreneurship incentives and subsidies – Determining Financial Needs – Sources of Financing: support for product development, funding agencies, collaborative initiatives, and angel investors. Impact of Globalization: Medical product manufacturing, marketing, leadership, quality management. Case studies.

UNIT V Marketing Function **9**

Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. Case study

45PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Describe the role of biomedical engineers in entrepreneurship
CO2: Interpret the background for biomedical engineers in entrepreneurship
CO3: Acquire the skills and techniques required towards innovation
CO4: Categorize the resources and funding agencies and judge the right product based on market needs
CO5: Compile and quantify the opportunities and challenges

TEXT BOOKS:

1. Jen-Shih Lee "Biomedical Engineering Entrepreneurship", World Scientific Publishing, USA. 2010
2. Vasant Desai, —The Dynamics of Entrepreneurial Development and Management||, Himalaya Publishing House, 2010.

REFERENCES:

1. Brant Cooper, Patrick Vlaskovits, "The Lean Entrepreneur", Wiley, 2nd edition, New Jersy, 2016
2. Nathan Furr, Jeff Dyer, "The Innovator's Method: Bringing the Lean Start-up into Your Organization", Harvard Business Press, Boston, 2014.
3. Donald F.Kuratko and Richard M. Hodgetts, "Entrepreneurship", South-Western.
4. Gupta S.L., Arun Mittal, "Entrepreneurship Development", International Book House, 2012
5. Prasanna Chandra, "Projects- Planning, Analysis, Financing, Implementation and review||, TATA McGraw Hill, 2012
6. Sudha G. S., "Management and Entrepreneurship Development", Indus Valley Publication, 2009

Course Code	**Hospital Automation**	L	T	P	C
BM4V27		3	0	0	3

COURSE OBJECTIVES:

- To understand the importance and application of Automation in Hospitals
- To learn the modern method of promoting Hospitals through the role of IT

UNIT I Introduction to Information Systems in Hospitals **9**

The need for Information systems – the Increasing Value of Information Technology – the Networking of computing – Business Process Re engineering – IT as a tool for competitive advantage.

UNIT II Hardware & Software Systems **9**

Computer Peripherals – Input Technology Trends – Voice Recognition and Response Optical Scanning – Output Technology and Trends – Video Output – Storage Trends Application software for End Users – word Processing and Desktop Publishing – systems Software – Operating Systems – security system

Unit III Database Management System & Electronic Commerce **9**

Foundation Data Concepts - The Database Management Approach – Types of Databases types of Databases – Database structure – Data Mining – Benefits and Limitations of Database

management. E-Commerce Application – Business to Consumer – Business – to Business Commerce.

UNIT IV Medical Records **9**

Role of Medical Records in Health Care Delivery – General Medical Records Standards and Policies – Legal Aspects of Medical Records –Medical Audit Computerization of Medical Records – Information Needs in the Hospital – sources of Health Information – User of Health and Hospital Data.

UNIT V Clinical Information Systems **9**

Management decision and Related Information Requirement – Clinical Information Systems – Administration Information systems - Support Service Technical Information Systems – Medical Transcription. **Total:45 Periods**

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Gain adequate knowledge about information systems in hospitals .
CO2: Get clear idea about implant design a hardware and software systems.
CO3: Have in-depth knowledge about database management system and electronics commerce.
CO4: Acquire the skills and techniques for handling medical records.
CO5: Access compatibility and functioning of clinical Information system

TEXT BOOKS & REFERENCES BOOKS:

1. Management Information System, James A.O' Brien, Tata Mc-graw Hill
2. Managing a Modern Hospital, A.V. Srinivasan, Response Books
3. Health Management Information System, Jack Smith, Open University Publication, U.K

Course Code	**Advanced In Healthcare Technology**	L	T	P	C
BM4V28		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Understand the needs for wearable devices and the technology
- Learn the concepts in digital health care and digital hospitals
- Apply the tools in design, testing and developing digital health care equipment

UNIT I Digital Health **9**

Digital Health: Requirements and best practices, Laws and regulations in Digital health, Ethical issues, barriers and strategies for innovation.

UNIT II Digital Radiology **9**

Digital radiology for digital hospital, picture archiving and communication, system integration, digital history of radiology, medical image archives, storage and networks.

UNIT III E-Health **9**

E-Health: Health care networking, medical reporting using speech recognition, physiological tests and functional diagnosis with digital methods, tele-consultation in medicine and radiology.

UNIT IV M-Health Care and Wearable Devices **9**

Introduction to mobile healthcare devices-economy-average length of stay in hospital, outpatient care, health care costs, mobile phones, 4G, smart devices, wearable devices, Uptake of e-health and m-health technologies. Standards, system Design and case study.

UNIT V Modality and Standards for Inter-Operability **9**

Multimodality registration in daily clinical practice. Mobile healthcare. Selection and Implementation in e-Health project, design of medical equipment based on user needs. Security and privacy in digital health care. Case study.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Interpret the need for digital methods of handling medical records
CO2: Explain the digital radiology.
CO3: Modify the tools and methods for work flow in E-Health
CO4: Identify the available technology for wearable healthcare devices
CO5: Compare various standards for inter-operability of devices, quality and safety standards for developing healthcare systems

TEXT BOOKS:

1. Christoph Thuemmler, Chunxue Bai, “Health 4.0: How Virtualization and Big Data are Revolutionizing Healthcare”, Springer, 1st ed. 2017
2. Wlater Hruby, “Digital revolution in radiology – Bridging the future of health care, second edition, Springer, New York. 2006.
3. Samuel A. Fricker, Christoph Thümmler , Anastasius Gavras, “Requirements Engineering For Digital Health”, Springer, 2015

REFERENCE:

1. Rick Krohn (Editor), David Metcalf, Patricia Salber, “Health-e Everything: Wearables and The Internet of Things for Health, ebook. 2013
2. Khandpur, R.S, “Handbook of Biomedical Instrumentation ”,Second Edition. Tata Mc Graw Hill Pub. Co., Ltd. 2003
3. John, G. Webster. Medical Instrumentation: Application and Design. Second Edition. Wiley Publisher, New Delhi. 2013.

VERTICAL 3 -BIOMECHANICS

Course Code	Biomechanics and Assistive Devices	L	T	P	C
BM4V31		3	0	0	3

COURSE OBJECTIVES:

- Explain the principles of mechanics.
- Discuss the mechanics of human motions in kinematics.
- Explain the mechanics of motions.
- Illustrate the knowledge of biomechanics in muscles.
- Apply design tools for modeling and analysis of assist devices

UNIT I Statics & Dynamics of Human Body 9

Statics: Review of forces, torques, and equilibrium, motion in one plane and levers, statics in the body, the sense of touch, units of force and pressure. Problems (2-D and 3-D).**Inverse dynamics –** with an example of reaching, interaction torques, computation of interaction torques.

UNIT II Advanced Kinematics 9

Defining body location, Defining body orientation, Transformation matrix, Rotation matrices, Forward kinematics, Kinematic chain, Velocity of Kinematic chain, Acceleration of kinematic chain, Inverse kinematics, 2-D and 3-D problems in human motion.

UNIT III Motion of Human Body 9

Kinematics and musculature, mechanics of standing, walking, running, jumping, throwing a ball and other types of motions, collisions of the human body, sustained acceleration, physics of sports.

UNIT IV Study of Muscles 9

Skeletal muscles in the body, the structure of muscles, passive muscles, activating muscles, a macroscopic view, the effect of exercise on muscles and their coordination, active/tetanized muscles, a microscopic view, hill force–velocity curve, the sliding filament model, a nanoscopic view.

UNIT V Sensory Augmentation and Substitutions 9

Classification of Visual Impairments, Prevention and cure of visual impairments, Visual Augmentation, Tactile vision substitution, auditory substitution and augmentation, tactile auditory substitution, Assistive devices for the visual impaired. IoT based assist devices.

TOTAL : 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: At the end of the course, the student should be able to:

CO1: Understand the principles of mechanics
CO2: Outline the principles of advanced kinematics.
CO3: Explain the fundamentals of motion of human body.
CO4: Apply the knowledge of mechanics in muscle.
CO5: Combine instrumentation techniques for development of assist devices to human needs

TEXT BOOKS:

1. Irving P. Herman, Physics of the Human Body, Springer, New York, NY, November 2006
2. Fundamentals of Neuromechanics by Valero Cuevas.
3. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, —Biometric Systems, Technology Design and Performance Evaluation||, Springer, 2005.
4. David D. Zhang, —Automated Biometrics: Technologies and Systems||, Kluwer Academic Publishers, New Delhi, 2000.
5. Arun A. Ross , Karthik Nandakumar, A.K.Jain, —Handbook of Multibiometrics||, Springer, New Delhi, 2006.
6. Kolff W.J, "Artificial Organs", John Wiley and Sons, New York, 1979.
7. Andreas.F.Vonracum,"Hand book of biomaterial evalution",Mc-MillanPublishers, 1980.

REFERENCES:

1. Zatsiorsky, Vladimir M. Kinetics of human motion. Human Kinetics, 2002.
2. Zatsiorsky, Vladimir M. Kinematics of Human Motion. Human Kinetics, 2002.
3. Zatsiorsky, Vladimir, and Boris Prilutsky. Biomechanics of skeletal muscles. Human Kinetics, 2012.
4. Albert M.Cook, Webster J.G., "Therapeutic Medical Devices", Prentice Hall Inc., New Jersey, 1982.
5. John. G. Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd, 2004.

Course Code	**Rehabilitation Engineering**	L	T	P	C
BM4V32		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Understand the sensory rehabilitation systems
- Learn the use of orthopedic prosthetics and orthotics in rehabilitation.
- Understand virtual reality in rehabilitation
- Learn the application of biomechanics into modelling and ergonomic design
- Have an understanding of rehabilitation medicine and advocacy

UNIT I Introduction to Rehabilitation **9**

Definition - Impairments, disabilities and handicaps, Primary and secondary disabilities, Activities of daily living, Appropriate Technology, Residual function. Rehabilitation. Rehabilitation

team – members and their functions. Rehabilitation care –Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects.

UNIT II Engineering Concepts in Sensory Augmentation and Substitution 9

Sensory augmentation and substitution- Visual system: Visual augmentation, Tactual vision substitution, and Auditory vision substitution. Auditory system- Auditory augmentation, Hearing aids, cochlear implants, visual auditory substitution, tactual auditory substitution. Tactual system - Tactual augmentation, Tactual substitution

UNIT III Orthopedic Prosthetics and Orthotics 9

Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

UNIT IV Virtual Reality 9

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT V Rbilitatehaion Medicine and Advocacy 9

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Summarize the key terminologies used by the rehabilitation team
CO2: Illustrate Engineering Concepts in Sensory & Motor rehabilitation.
CO3: Design different orthotics and prosthetics for rehabilitation applications.
CO4: Summarize the need of virtual reality tools for different aids.
CO5: Appraise the legal aspects for building rehabilitation aids for the needed people

TEXT BOOKS:

1. Joseph D Bronzino, “The Biomedical Engineering Handbook”. 2nd edition, CRC Press, 2000.
2. Robinson C.J, “Rehabilitation Engineering”, CRC Press, 2006

REFERENCE:

1. Sashi S Kommu, “Rehabilitation Robotics”, 1st edition, CRC Press, 2007
2. Sunder, “Textbooks of Rehabilitation”, Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007

3. Horia- Nocholai Teodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation Engineering", CRC; December 2000
4. Etienne Grandjean, Harold Oldroyd, "Fitting the task to the man", Taylor & Francis, 1988.
5. Keswick. J., "What is Rehabilitation Engineering, Annual Reviews of Rehabilitation", Springer Verlag, New York, 1982
6. Warren E. Finn, Peter G. Lopressor, "Handbook of Neuroprosthetic Methods",CRC, 2002.
7. Roy A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), "An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering" CRC Press, 2000S

Course Code	**Ergonomics**	L	T	P	C
BM4V33		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To get exposed to principles of visual capabilities
- To learn the mechanics of muscle physiology and significance of rest cycle.
- To learn spatial compatibility and the relation between control orders and control response
- To know about the measurements and proportions of the human body
- To be familiar with the mathematical models, analysis and design of biomedical devices using case studies.

UNIT I Visual and Auditory Ergonomics **9**

Process of seeing – visual capabilities – factors affecting visual acuity and contrast sensitivity – human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual display – process of hearing – principles of auditory display. Measures for monitoring control & mitigation.

UNIT II Muscle Physiology **9**

Muscle physiology – muscle metabolism – respiratory response – joint motion study – measure of physiological in-efficiency and energy consumption – work rest cycles – aspects of manual and posture study, material handling (MMH) Bio-mechanical recommended limits of MMH

UNIT III Controls and Displays **9**

Spatial compatibility and physical arrangement of displays and controls - Design of displays and controls – movement capability – rotary controls and rotor displays movement of displays orientation of the operator and movement relationships control orders and control responses – human limitations in tracking task.

UNIT IV Anthropometry **9**

Anthropometry – anthropometric design principles – Physical work load and energy expenditure - work space envelope – factors in design of work space surfaces – principles of seat design – principles of control panel. ergonomic implications. Organization classification of human errors theories of accident causation-reducing accidents by altering behavior

UNIT V Case Studies **9**

Case Study 1: computer design, control panel design of an electronic instrument, computer key board, hand drill etc

Case Study 2: Biomedical Application, Design optimization of Medical Equipment.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand principles of ergonomics
CO2: Understand the significance of posture
CO3: Learn about tracking tasks.
CO4: Learn about ergonomics and its implications to various domain.
CO5: Perform case studies on electronic instruments and medical equipment. .

TEXT BOOKS:

1. Pascale Carayon, "Handbook of Human Factors and Engineering", Second Edition, CRC Press, 2011.
2. Martin Helander, "Guide to Human Factors and Ergonomics", Second Edition, CRC Press, 2005
3. Benjamin W.Niebel, "Motion and Time Study", Richard, D. Irwin Inc., Seventh Edition, 2002

REFERENCES:

1. Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press2007
2. George Kanawaty, "Introduction to work study", ILO, 3rd edition, Oxford & IBH publishing, 2001
3. Stephen Pheasant, Christine M. Haslegrave, Bodyspace: Anthropometry, Ergonomics and the Design of Work, CRC Press, 2005.

Course Code	**Physiological Modelling and Haptics**	L	T	P	C
BM4V34		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Understand the sensory rehabilitation systems
- Learn the use of orthopedic prosthetics and orthotics in rehabilitation.
- Understand virtual reality in rehabilitation
- Learn the application of biomechanics into modelling and ergonomic design
- Have an understanding of rehabilitation medicine and advocacy

UNIT I Introduction to Rehabilitation **9**

Definition - Impairments, disabilities and handicaps, Primary and secondary disabilities, Activities of daily living, Appropriate Technology, Residual function. Rehabilitation. Rehabilitation team – members and their functions. Rehabilitation care –Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects.

UNIT II Engineering Concepts in Sensory Augmentation and Substitution **9**

Sensory augmentation and substitution- Visual system: Visual augmentation, Tactual vision substitution, and Auditory vision substitution. Auditory system- Auditory augmentation, Hearing aids, cochlear implants, visual auditory substitution, tactual auditory substitution. Tactual system - Tactual augmentation, Tactual substitution

UNIT III Orthopedic Prosthetics and Orthotics **9**

Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

UNIT IV Virtual Reality **9**

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT V Rbilitatehaion Medicine and Advocacy **9**

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Summarize the key terminologies used by the rehabilitation team
CO2: Illustrate Engineering Concepts in Sensory & Motor rehabilitation.

CO3: Design different orthotics and prosthetics for rehabilitation applications.
CO4: Summarize the need of virtual reality tools for different aids.
CO5: Appraise the legal aspects for building rehabilitation aids for the needed people

TEXT BOOKS:

1. Joseph D Bronzino, "The Biomedical Engineering Handbook". 2nd edition, CRC Press, 2000.
2. Robinson C.J, "Rehabilitation Engineering", CRC Press, 2006

REFERENCE:

1. Sashi S Kommu, "Rehabilitation Robotics", 1st edition, CRC Press, 2007
2. Sunder, "Textbooks of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007
3. Horia- Nocholai Teodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation Engineering", CRC; December 2000
4. Etienne Grandjean, Harold Oldroyd, "Fitting the task to the man", Taylor & Francis, 1988.
5. Keswick. J., "What is Rehabilitation Engineering, Annual Reviews of Rehabilitation", Springer Verlag, New York, 1982
6. Warren E. Finn, Peter G. Lopressor, "Handbook of Neuroprosthetic Methods",CRC, 2002.
7. Roy A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), "An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering" CRC Press, 2000S

Course Code	**Computational Fluid Dynamics**	L	T	P	C
BM4V35		3	0	0	3

COURSE OBJECTIVES:

The students should be made**:**

- To understand the basics of fluid mechanics
- To analyze cellular, ocular, cardiovascular and respiratory fluid mechanics.
- To learn mathematical modelling of fluid biological systems
- To Understand the physics of Valvular disease
- To Learn the law of fluids, Algorithms for Pressure-Velocity, CFD Codes

UNIT I Biofluid Mechanics **9**

Intrinsic fluid properties - Density, Viscosity, Compressibility, Surface tension, Hydrostatics Fluid characteristics and viscosity – Displacement and velocity, Sheer stress and viscosity Bernoulli equation, Introduction to pipe flow – Reynolds number, Poiseuille's law, Flow Rate, Womersley number, Constitutive equations – Newtonian fluid, Non-Newtonian viscous fluid, Diameter, velocity and pressure of blood flow relationship, Resistance against flow, Viscoelasticity – Viscoelastic models, Response to Harmonic variation, Use of viscoelastic models, Bio-Viscoelastic fluids – Protoplasm, Mucus, Saliva, Synovial fluids..

UNIT II Cellular and Occular Mechanics **9**

Cellular Biomechanics – Eukaryotic cell architecture, Cytoskeleton, Cell-matrix interactions, Mechanical property measurement – Atomic Force microscopy, Optical Trapping, Magnetic bead microrheometry, Micropipette aspiration, Models of cellular biomechanical behavior, Computational model of a chondrocyte in its matrix, Mechanotransduction, Techniques for mechanical stimulation of the cells, Tissue cell mechanobiology – Endothelial, smooth muscle cells, Chondrocytes, Osteoblasts, Ocular Biomechanics – Occular anatomy, Biomechanics of Glaucoma, Ocular blood flow.

UNIT III Blood Rheology and Blood Vessel Mechanics **9**

Viscometry, Elements of Blood, Blood characteristics – Viscosity of blood, Einstein's equation, Biomechanics of red cell membrane, Apparent and relative viscosity, Blood viscosity variation, Casson's equation, Rheology of Blood In Micro vessels – Fahraeus-Lindquist effect and its inversion, Anatomy and physiology of blood vessels, Arterial wall as membrane – Uniaxial loading, Biaxial loading, Torsion, Hemodynamics of Large arteries – Ventricular outflow and the aorta, Pressure-flow relations and Vascular Impedance, Wave propagation and reflection.

UNIT IV Cardio Respiratory Mechanics and Space Medicine **9**

Cardiac cycle – Pressure volume diagrams, Changes in contractility, Ventricular performance, Congestive heart failure, Pulsality index, Physics of valvular diseases, Prosthetic heart valves and replacements, Respiratory System – Alveolar ventilation-lung volumes and capacities, Mechanics of breathing, Work of breathing – Lung compliance, Airway resistance, Gas exchange and transport, Oxygen dissociation curve, Lung surfactant, Pulmonary pathologies, Space Medicine – Hypoxia, Physiology of decompressive sickness, Human response to acceleration, Thermal Stress...

UNIT V Computational Fluid Dynamics **9**

Computational fluid dynamics – CFD Code, Problem solving with CFD, Conservation Laws of Fluid Motion and Boundary Conditions, Turbulence and its modelling, The Finite Volume Method for Diffusion Problems and Convection-Diffusion Problems, Solution Algorithms for Pressure-Velocity Coupling in steady flows, Solution of Discretized Equations, The Finite Volume Method for Unsteady flows, Implementation of Boundary Conditions Application – Multiphysics computational models for cardiac flow and virtual cardiography.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the basics of Fluid Mechanics
CO2: Construe the intracellular fluid mechanics and ocular mechanics
CO3: Describe the rheology of blood and mechanics of blood vessels.
CO4: Elucidate on cardiorespiratory mechanics and space medicine.

CO5: Develop mathematical models of biological systems with fluids. .

TEXT BOOKS:

1. Krishnan B. Chandran, Ajit P. Yoganathan, Stanley E. Rittgers, "Biofluid Mechanics- The human circulation", CRC Taylor and Francis, 2007.
2. Y.C Fung, "Biomechanics- Mechanical properties of living tissues", 2nd Edition, Springer Verlag,1993

REFERENCES:

1. H K Versteeg, W Malalasekera, "An Introduction to Computational Fluid Dynamics The Finite Volume Method", Longman Scientific and Technical, 1995
2. Lee Waite, Jerry Fine, "Applied Biofluid Mechanics", McGraw Hill, 2007.
3. John K-J Li, "Dynamics of Vascular System", World Scientific, 2004

Course Code	**Computational Modelling and Simulation**	L	T	P	C
BM4V36		3	0	0	3

6

COURSE OBJECTIVES:

The students should be made:

- To give an overview of various methods of process modeling, different computational techniques for simulation.

UNIT I Introduction **9**

Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT II Steady State Lumped Systems **9**

Degree of freedom analysis, single and network of process units, systems yielding linear and non-linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.

UNIT III Unsteady State Lumped Systems **9**

Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems..

UNIT IV Steady State Distributed System **9**

Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT V Unsteady State Distributed System Other Modelling Approaches **9**

Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling...

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understood the development of process models
CO2: Illustrate the conservation principles and
CO3: Analyse the process data
CO4: Demonstrate the computational techniques
CO5: To solve the process models.

TEXT BOOKS:

1. Ramirez, W.; "Computational Methods in Process Simulation", 2nd Edn., Butterworths Publishers, New York, 2000.
2. Luyben, W.L., "Process Modelling Simulation and Control ",2nd Edn, McGraw-Hill Book Co., 1990 Human Circulation, Taylor and Francis, 2007.

REFERENCES:

1. Felder, R. M. and Rousseau, R. W., " Elementary Principles of Chemical Processes ", John Wiley, 2000.
2. Franks, R. G. E., "Mathematical Modelling in Chemical Engineering ", John Wiley, 1967.
3. Amiya K. Jana, "Process Simulation and Control Using ASPEN", 2nd Edn,PHI Learning Ltd (2012).

Course Code	**Assistive Technology**	L	T	P	C
BM4V37		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To know the hardware requirement various assistive devices.
- To understand the prosthetic and orthotic devices
- To know the developments in assistive technology

UNIT I Cardiac Assist Devices **9**

Principle of External counter pulsation techniques, intra aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves.

UNIT II Hemodialysers **9**

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters

UNIT III Hearing Aids **9**

Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV Prosthetic and Orthodic Devices **9**

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthodic system, functional electrical stimulation, sensory assist devices.

UNIT V Recent Trends **9**

Transcutaneous electrical nerve stimulator, bio-feedback.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Interpret the various mechanical techniques that will help in assisting the heart functions.
CO2: Describe the underlying principles of hemodialyzer machine
CO3: Indicate the methodologies to assess the hearing loss
CO4: Evaluate the types of assistive devices for mobilization.
CO5: Explain about TENS and biofeedback system.

TEXT BOOKS:

1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press,2006
2. Marion. A. Hersh, Michael A. Johnson,Assistive Technology for visually impaired and blind,Springer Science & Business Media, 1st edition, 12-May-2010
3. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition,2010.

REFERENCES:

1. Kenneth J. Turner Advances in Home Care Technologies: Results of the match Project, Springer, 1stedition, 2011.

2. Gerr M. Craddock Assistive Technology-Shaping the future, IOS Press, 1st edition, 2003.
3. 3D Printing in Orthopaedic Surgery, Matthew Dipaola, Elsevier 2019 ISBN 978 -0-323-662116
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

Course Code	**Quantum Computing**	L	T	P	C
BM4V38		3	0	0	3

COURSE OBJECTIVES:

- To know the background of classical computing and quantum computing.
- To learn the fundamental concepts behind quantum computation.
- To study the details of quantum mechanics and its relation to Computer Science.
- To gain knowledge about the basic hardware and mathematical models of quantum computation.
- To learn the basics of quantum information and the theory behind it.

UNIT I Quantum Computing Basic Concepts **9**

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits - Superpositions

UNIT II Quantum Gates and Circuits **9**

Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction

UNIT III Quantum Algorithms **9**

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm

UNIT IV Quantum Information Theory **9**

Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels

UNIT V Quantum Cryptography **9**

Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution - BB84 - Ekart 91

TOTAL:45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Understand the basics of quantum computing.
CO2: Understand the background of Quantum Mechanics.
CO3: Analyze the computation models.
CO4: Model the circuits using quantum computation. environments and frameworks.
CO5: Understand the quantum operations such as noise and error–correction.

TEXTBOOKS:

1. Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition (1 November 2020).
2. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
3. Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computing for Everyone".

REFERENCES

1. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
2. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

VERTICAL 4 -INSTRUMENTATION AND COMMUNICATION

Course Code	**Advanced Computing System**	L	T	P	C
BM4V41		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To learn the principles of biomechanical therapeutic equipment.
- To introduce the basic concepts of body care and dental care equipment.
- To enable the students to gain knowledge on the working of ventilators and anaesthesia system
- To acquaint the knowledge of testing of hypothesis for small and large samples this plays an important role in in-vivo diagnosis.

UNIT I Biomechanical Therapeutic Equipment 9

Electrodiagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine -Traction Table.

UNIT II Body Care Equipment **9**

Skin Treatment: Ultrasonic spot remover, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation. Laser hair therapy machine. Body Slimmer/Shaper – Deep Heat Therapy, Massager, Fitness – Treadmill, Bike.

UNIT III Dental Care Equipment **9**

Dental Chair - Dental Handpieces and Accessories: Evolution of rotary equipment, Low-speed handpiece, High-speed handpiece, Handpiece maintenance. Vacuum and Pneumatic techniques: Vacuum techniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor. Decontamination Unit and constant fumigation unit. Dental Radiography: Dental X-ray Machine.

UNIT IV Ventilators and Anaesthesia System **9**

Basic principles of ventilators, Different generators, Inspiratory phase and expiratory phase, Different ventilator adjuncts, Neonatal ventilators, Ventilator testing - Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Anaesthesia - Need of anaesthesia, Gas used and their sources, Gas blending and vaporizers, Anaesthesia delivery system, Breathing circuits.

UNIT V Analytical & In-Vivo Diagnostic Instruments **9**

Common analytical equipment used in hospitals and those in Biochemistry laboratories - Immunoassay Analyzer, Hemostasis Analyzer, Biochemistry Analyzers: Semi-Auto Analyzer, Hematology Analyzer, Complete Blood Count Machines, Point-of-care biochemical analysis, Clinical Microbiology Lab Equipments: nephelometer, Automated Inoculation Delivery System.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the fundamental knowledge of the concepts of therapeutic equipment used in biomechanics.
CO2: Understand the basic concepts of body care equipment.
CO3: Intuit the application of dental care equipment and its range of operation.
CO4: Summarize the variety of ventilator and anaesthesia delivery system
CO5: Comprehend the working principle and applications of the analytical equipment used in in-vivo diagnosis.

TEXT BOOKS:

1. Carr –Brown, “Introduction to Biomedical Equipment Technology”, 2011, 1st Edition, Pearson, New York
2. John G. Webster, “Medical Instrumentation Application and Design”, 2015, 4th Edition, John Wiley and sons, New Jersey

REFERENCES:

1. R S. Khandpur, "Handbook of Biomedical Instrumentation", 2014, 3rd Edition, Tata Mc Graw Hill, New Delhi.
2. Leslie Cromwell, Fred. J. Weibell & Erich. A.Pfeiffer. "Biomedical Instrumentation and Measurements". Second Edition. Prentice Hall Inc.2000.
3. Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall and Technology, 2008.

Course Code	BIOMEMS	L	T	P	C
BM4V42		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- Understand various mechanical and thermal sensors and actuators and their principles of
- operation at the micro scale level
- Understand various electrostatic and piezoelectric sensors and actuators at the micro scale level.
- Introduce microfluidic systems
- Know on the applications of MEMS in different field of medicine

UNIT I MEMS Materials and Fabrication 9

Semiconductor materials; photo lithography; doping; thin film growth and deposition; CVD and Ion Implantation, metallization; wet and dry etching; silicon micromachining; metal MEMS processes; submicron optical lithography; electron beam lithography; soft lithography and printing

UNIT II Mechanical and Thermal Sensors and Actuators 9

Mechanical sensors and actuators – beam and cantilever –microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor

UNIT III Electrostatic and Piezoelectric Sensors and Actuator 9

Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor

UNIT IV Microfluidic Systems 9

Laminar flow in circular conduits, fluid flow in micro conduits, in submicrometer and nanoscale. Microfluidic components (filters, mixers, valves, and pumps)

UNIT V Applications of Biomems 9

CAD for MEMS, DNA sensor, MEMS based drug delivery, Biosensors- sensors for glucose, uric acid, urea and triglyceride sensor. Introduction to the MATLAB / Simulink / CAD tool for modelling / simulations of bioelectronics systems.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Summarize various MEMS fabrication techniques.
CO2: Elucidate different types of mechanical and thermal sensors and actuators and their principles of operation at the micro Scale level.
CO3: Describe different types of various electrostatic and piezoelectric sensors and actuators and their principles of operation at the micro Scale level.
CO4: Explain microfluidic systems
CO5: Illustrate MEMS in different field of medicine.

TEXT BOOKS:

1. TaiRan Hsu, MEMS and Microsystems Design and Manufacture, Tata McGraw Hill Publishing Company, New Delhi, 2017.
2. Wanjun Wang and Stephen A. Soper, BioMEMS: Technologies and Applications, CRC Press, NewYork, 2007.
3. Chang Liu, Foundations of MEMS, Pearson Education International, New Jersey, USA, 2011.
4. Ellis Meng, Biomedical Microsystems, CRC Press, Boca Raton, FL, 2011.
5. P. Tabeling, S .Chen, Introduction to microfluidics, Oxford University Press, 2010.
6. Alok Pandya, Vijai Singh, Micro/Nanofluidics and Lab-on-Chip Based Emerging Technologies for Biomedical and Translational Research Applications - Part B, Academic Press, 2022

Course Code	**Medical System Instrumentation**	L	T	P	C
BM4V43		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To understand the generation of X-ray and its uses in Medical imaging.
- To describe the principle of Computed Tomography.
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging.
- To discuss the radiation therapy techniques and radiation safety.

UNIT I X Rays **9**

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method.

UNIT II Computed Tomography **9**

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method.

UNIT III Magnetic Resonance Imaging **9**

Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, Fmri..

UNIT IV Nuclear Imaging **9**

Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET..

UNIT V Radiation Therapy and Radiation Safety **9**

Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Describe the working principle of the X-ray machine and its application.
CO2: Illustrate the principle computed tomography
CO3: Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.
CO4: Demonstrate the applications of radionuclide imaging.
CO5: Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety

TEXT BOOKS:

1. Isaac Bankman, I. N. Bankman , Handbook of Medical Imaging: Processing and Analysis (Biomedical Engineering), Academic Press,2000

2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume
3. Medical Image Processing and Analysis, SPIE Press 2000 3. Khin Wee Lai, Dyah Ekashanti Octorina Dewi "Medical Imaging Technology", Springer Singapore, 2015

REFERENCE:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003.
2. Dougherty, Geoff (Ed.), "Medical Image Processing - Techniques and Applications", Springer-Verlag New York, 2011

Course Code	Electrical Safety And Quality Assurance	L	T	P	C
BM4V44		3	0	0	3

COURSEOBJECTIVES:

The students should be made:

- To provide electrical protection and maintenance in working environment and ensure that electrical safety.

UNIT I Electrical Hazards **9**

Review of Electrical concept, Electrostatic – Electro magnetism – Electrical Hazards – Energy leakage – Clearance and insulation– Current surges – Electrical causes of fire and explosion – Human interface with electricity – Human resistance to electricity.

UNIT II Standards and Requirements **9**

National electrical Safety code - Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate. Hazardous area classification and classification of electrical equipment's for hazardous areas (IS, NFPA, API and OSHA standards).

UNIT III Electrical Protection and Maintenance **9**

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance. First aid-cardio pulmonary resuscitation (CPR).

UNIT IV Standardization of Quality Medical Care in Hospitals **9**

Define Quality - Need for Standarization & Quality Management, QM in Health care organization Quality assurance methods, QA in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipments..

UNIT V Regulatory Requirement for Health Care **9**

CE and FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, Other regulatory Codes

45PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: to develop knowledge and insight into the procedures used in quality control and assurance activities as well as safety measures to be followed in hospitals

TEXT BOOKS:

1. B.M. Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd.24
2. K.Shridhara Bhat, Quality Management, Himalaya Publishing House Cesar A. Cacere & Albert Zana, The Practice of Clinical Engg. Academic press, New York, 1977.

REFERENCES:

1. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentice Hall Inc., Engle wood Cliffs, New Jersy, 1979
2. Karen Parsley, Karen Parsley Philomena Corrigan" Quality improvement in Healthcare, 2nd edition, Nelson Thrones Pub, 2002
3. Sharon Myers "Patient Safety & Hospital Accreditation - A Model for Ensuring Success" Springer Publishers 2012 7. Joseph F Dyro "Clinical Engineering Handbook", Elsevier Publishers, 2004

Course Code	Electronic systems for cancer diagnosis	L	T	P	C
BM4V45		3	0	0	3

Course Objectives:

- To understand the principles of tissue-related cancers, focusing on breast and oral cancer and to learn the current gold standards in cancer diagnosis.
- To develop diagnostic strategies based on changes in cell and tissue morphology , to Gain practical knowledge of tissue culture methods and maintaining cells.
- To explore 3D printing for electronic system packaging.
- To design electronic systems for early cancer diagnosis and cytology studies , to integrate electronic systems with biochips for tissue property analysis.
- To operate in a clean room environment and perform lithography for cancer diagnosis tools.

Prerequisites:

- Basic knowledge of electronics and electrical engineering
- Understanding of biological concepts and medical terminology

UNIT 1: Introduction to Tissue-Related Cancers and Diagnostic Standards

Understanding Morphological Changes: Changes in cell and tissue morphology during cancer progression, Diagnostic strategies based on morphological changes, Overview of tissue-related cancers: breast cancer and oral cancer, Types and characteristics of breast and oral cancers, Importance of early diagnosis and treatment, Current gold standards in cancer diagnosis

UNIT 2: Tissue Culture Methods and Cell Maintenance

Basics of Tissue Culture Methods: Introduction to tissue culture methods, Types of cell growth: monolayer and suspension cultures, Work area and equipment: laminar flow hoods, CO2 incubators, microscopes, Preservation techniques, vessels, and storage , Maintaining Cells: Harvesting cells and maintaining cell cultures, Media and growth requirements, Safety considerations in cell culture

UNIT 3: 3D Printing in Electronic System Packaging

Understanding 3D Printing and its Use: Basics of 3D printing technology, Applications of 3D printing in electronic systems for cancer diagnosis, Packaging and press-fit contacts in electronic diagnostic systems, Hands-On Experience in 3D Printing: Designing a 3D printed casing for electronic system packaging

UNIT 4: Designing Electronic Diagnostic Systems

Designing Systems for Early Cancer Diagnosis: Process for designing electronic systems based on tissue images, Tools and software for design and simulation, Case studies and practical examples

UNIT 5: Advanced Electronic Systems and Clean Room Practices

Electronic Systems Integrated with Biochips:Integration of electronic systems with biochips, Understanding changes in electro-thermo-mechanical properties of tissue, Case studies and practical examples

Working in a Clean Room Environment: Introduction to clean room practices (non-conventional Class 10000), Inspection and maintenance of cancer diagnosis tools, Basic training on operating clean room tools, Case studies and Example

Final Week: Review and Examination

- Review of key concepts and course content
- Final examination

Evaluation:

- Assignments: 20%
- Quizzes: 10%
- Midterm Exam: 20%
- Project: 30%
- Final Exam: 20%

Recommended Textbooks:

- "Biomedical Engineering: Bridging Medicine and Technology" by W. Mark Saltzman
- "Principles of Biomedical Engineering" by Sundararajan V. Madihally
- "Biosensors and Cancer" edited by Victor R. Preedy

References :

- D. Plummer, M.D. Deal, P.G. Griffin, Silicon VLSI Technology, Pearson Education, 2001.
- S.A. Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford University Press, 2001.
- S.M. Sze (Ed), VLSI Technology, 2nd Edition, McGraw Hill, 1988Senturia S. D., Microsystem Design, Kluwer Academic Publisher, 2001Madou, M Fundamentals of Microfabrication, CRC Press, 1997.Gad-el-Hak, M., Ed.;
- The MEMS Handbook; CRC Press: New York, NY, 2002.Mather J. P., Roberts P. E., Introduction to Cell and Tissue Culture, Springer, 1997.
- M. C. Phelan, UNIT 1.1 Basic Techniques for Mammalian Cell Tissue Culture, John Wiley and Sons, Inc, 2001.

Course Code	Telehealth Care and Communication	L	T	P	C
BM4V46		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Introduce the concept of telemedicine.
- Understand the Benefits and Limitations of Telemedicine
- Know Security and Standards and their use in Telemedicine Applications
- Introduce the need of telemedicine
- Make them Understand about the use of Telehealth care and Communication

UNIT I Introduction to Telemedicine **9**

Data types, Data acquisition Systems, Display Systems, Data Storage Systems, Communication Networks

UNIT II Multimedia Data Exchange and Telemedicine Quality Control **9**

Networking Architecture, Protocol Hierarchies for Multimedia communication, Media Coding. Data analytics in telemedicine. Artificial intelligence in medical coding.

UNIT III Internet in Telehealth Care **9**

Security, Quality of Service, Personal Communication, Medical Data Sharing, Telemedicine Needs, E-mail applications, World Wide Web, Teleworking, Tele teaching, Organizational Environment – Teleworking design and development.

UNIT IV Data Handling **9**

Data security and privacy, Mechanism of security, Security on Internet, security and legal issues, Liability and legal aspects, Main Deontological applications, Contract scenarios, legal protection

UNIT V Planning and Other Social Aspects **9**

Constraints for use of telehealth care, Costs/benefits, Planning for implementation, Forces affecting technology transfer, Scenarios for technology transfer, Technology transfer requirements, Strategy of telehealth care

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon successful completion of the course, students will be able to

CO1: Comprehend the various types of information
CO2: Realize the various data acquisition and storage system

CO3: Describe the issues in data handling and strategic Planning.
CO4: Describe the role of Internet in telemedicine.
CO5: Apply telemedicine in different fields like cardiology, oncology, pathology etc

TEXT BOOKS

1. Olga Ferrer-Roca, M.SosaLudicissa, "Handbook of Telemedicine", IOS press 2002
2. A.C.Norris, "Essentials of Telemedicine and Telecare", John Wiley & Sons, 2002.

REFERENCES

1. E-Health, Telehealth, and Telemedicine: A Guide to Startup and Success By Marlene Maheu, Pamela Whitten, Ace Allen E-Health, 2001.
2. Current Principles and Practices of Telemedicine and E-health, RifatLatifi, IOS Press, 2008.
3. Steven F. Viegas, Kim Dunn, "Telemedicine: Practicing in the Information Age, 2000
4. Richard Wootton, John Craig, Victor Patterson, "Introduction to Telemedicine, second edition, 2013

Course Code	**Wireless Technology**	L	T	P	C
BM4V47		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To understand the concept about Wireless networks, protocol stack and standards
- To understand and analyse the network layer solutions for Wireless networks
- To study about fundamentals of 3G Services, its protocols and applications
- To have in depth knowledge on internetworking of WLAN and WWAN
- To learn about evolution of 4G Networks, its architecture and applications

UNIT I Fundamentals of Wireless Communication **9**

Introduction to wireless communication – Multiple Access Techniques – FDMA, CDMA, TDMA, OFDMA, Spread Spectrum Techniques – DSSS, FHSS; Evloution of Wireless generations – 1G to 5G – Massive MIMO

UNIT II Wide Area Wireless Networks **9**

Principle of Cellular Communication – Frequency Reuse – Cluster – GSM, GPRS – UMTS, CDMA 2000, LTE network architecture – Overview of LoRa & LoRaWAN.

UNIT III Wireless Metropolitan and Local Area Networks **9**

IEEE 802.16 (WiMax) – IEEE 802.11 (WiFi) – Architecture, Protocol Stack, Enhancement and Applications – Self Learning: Wireless Local Loop (WLL).

UNIT IV Wireless Personal Area Networks and Adhoc Networks **9**

IEEE 802.15.1 (Bluetooth) – IEEE 802.15.4 (Zigbee) – Wireless Sensor Network – Design considerations, Issues and Challenges – WSN architecture applications – Introduction to Ad hoc networks – MANET and VANET – Overview of E-VANET (Electrical Vehicular Adhoc Network) – Self Learning: HR-WPAN (UWB)

UNIT V Wireless Network Security **9**

Security in GSM – UMTS security – Bluetooth security – WEP; WPA2 – Self Learning: Study of Wireless Security Tools

TOTAL : 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Identify and choose wireless transmission standard, physical layer protocol and MAC layer protocol on the basis of various network applications.
CO2: Understand and explain mobile IP and data routing using it. Classify ad hoc network protocols.
CO3: Understand the TCP protocol for wireless networks and able to do congestion free transmission over wireless networks.
CO4: Understand the major concepts involved in wireless wide-area networks and its architecture.
CO5: Have knowledge of 4G technologies and analyze various smart antenna techniques, modulation and coding techniques used in 4G technology.

TEXT BOOKS:

1. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education 2012.
2. Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier 2007.

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", First Edition, Elsevier 2011.
3. Simon Haykin, Michael Moher, David Koilpillai, "Modern Wireless Communications", First Edition, Pearson Education 2013

Course Code	**Cyber Security**	L	T	P	C
BM4V48		3	0	0	3

COURSE OBJECTIVES:

- To develop a comprehensive understanding of fundamental cybersecurity concepts, including cyber threats, preventive measures, and cyber security principles.
- To explore networking basics, focusing on concepts, protocols, and architectures crucial to understanding cyber security measures.
- To acquire knowledge on core security principles, including risk management practices, to build a solid foundation for implementing effective security measures.

- To understand the principles of cryptography and encryption, exploring their role in securing data and communication channels in cybersecurity.
- To develop the skills to create, implement, and enforce security policies and procedures, fostering a security-aware culture and mitigating cyber threats through effective governance.

UNIT I Introduction to Cyber Security Concepts **9**

Introduction to Cybersecurity Fundamentals - Cyber Threat Landscape - Cybersecurity Frameworks and Standards - Security Architecture and Models - Incident Response and Cybersecurity Incident Handling - Security Awareness and Training - Legal and Ethical Aspects of Cybersecurity - Emerging Trends in Cybersecurity.

UNIT II Fundamentals of Networking **9**

Introduction to Networking Concepts - OSI Model Overview - TCP/IP Protocol Suite - Network Devices and Components - IP Addressing and Subnetting - Routing and Switching Basics - Wireless Networking Fundamentals - Network Security Principles.

UNIT III Security Fundamentals **9**

Introduction to Security Principles - Access Control and Authentication - Security Risk Management - Security Policies and Procedures - Security Incident Response - Security Awareness Training - Vulnerability Assessment and Management - Physical Security Considerations

UNIT IV Cryptography and Encryption **9**

Introduction to cryptography - symmetric encryption algorithms - asymmetric encryption and public key infrastructure (PKI) - hash functions and message digests - digital signatures - cryptographic key management - transport layer security (TLS) and secure sockets layer (SSL) - cryptography in blockchain technology.

UNIT V Security Policies and Procedures **9**

introduction to security policies and procedures - policy development and implementation - access control policies - data classification and handling policies - incident response plans - security awareness training programs - compliance and regulatory policies - security auditing and monitoring procedures.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Gain a clear understanding of fundamental cybersecurity principles, exploring the core concepts that form the basis of cyber defense.

CO2: Understand the application of cybersecurity policies and risk management practices, emphasizing their importance in maintaining a secure digital environment.

CO3: Learn about the basic tools and techniques for investigating various cybercrimes, providing a foundational knowledge base for cybercrime detection and resolution.
CO4: Apply security fundamentals to digital environments, incorporating knowledge of risk management, access control, and other core principles to enhance overall security.
CO5: Demonstrate proficiency in cyber forensics techniques and methodologies, integrating knowledge from security policies and procedures to enhance investigative capabilities

TEXT BOOK LINKS:

Unit 1: Introduction to Cybersecurity by jeetendra pande
https://uou.ac.in/sites/default/files/slm/Introduction-cyber-security.pdf
Unit 2: Fundamentals of Networking: https://www.cisco.com/c/dam/global/fi_fi/assets /docs/SMB_University_120307_Networking_Fundamentals.pdf
Unit 3: Security Fundamentals:
https://training.apnic.net/wp-content/ uploads/sites/2/2016/11/eSEC01_NetSec.pdf
Unit 4: Cryptography and Encryption:
https://www.cs.umd.edu/~waa/414-F11/IntroToCrypto.pdf
Unit 5: Security Policies and Procedures:
https://oklahoma.gov/content/dam/ok/en/omes/documents/InfoSecPPG.pdf

REFERENCE BOOKS:

1. Diogenes, Y., & Ozkaya, E. (2018). Cybersecurity - Attack and defense strategies: Infrastructure security with red team and blue team tactics. Packt Publishing.
2. Schneier, B. (2017). Applied cryptography: Protocols, algorithms and source code in C. John Wiley & Sons.
3. Erickson, J. (2008). Hacking: The art of exploitation (2nd ed.). No Starch Press.

VERTICAL 5 - EMBEDDED, SIGNAL AND IMAGE PROCESSING

Course Code	Real Time Operating Systems	L	T	P	C
BM4V51		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals of operating systems and their importance in real time applications
- To provide necessary basics on how a real-time operating system designed and their importance in embedded system design.
- To know the basic real time models and languages.
- To study the implementation of some applications of real-time operating system implemented with their architectural features.
- To apply the basic knowledge in understanding the simple embedded systems in RTOS environment.

UNIT I Review of Operating Systems **9**

Basic Principles-system calls-Files-Processes-Design and implementation of processes-Communication between processes - operating system structures.

UNIT II Distributed Operating Systems **9**

Topology-Network Types-Communication-RPC-Client server model-Distributed file systems.

UNIT III Real Time Models and Languages **9**

Event based–Process based-Graph models-Pettrinet models-RTOS tasks-RT scheduling–Interrupt processing-Synchronization –Control blocks-Memory requirements.

UNIT IV RTOS and Application Domains **9**

RTOS for image processing- Embedded RTOS for voice over IP-RTOS for fault tolerant applications- RTOS for control systems.

UNIT V Case Studies **9**

Case Studies of RTOS RT Linux, Micro C/OS-II, Vx Works, Embedded Linux, Tiny OS, and Basic Concepts of Android OS.

TOTAL :45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: At the end of the course, the students should be able to:

CO1: Understand the fundamentals of operating systems and their importance in real time applications

CO2: Gain knowledge how a real-time operating system designed and their importance in embedded system design.
CO3: Understand the basic real time models and languages.
CO4: Interpret some applications of real-time operating system implemented with their architectural features.
CO5: Demonstrate the simple embedded systems in RTOS environment.

TEXT BOOKS

1. Hermann K, "Real time systems-design principles for distributed embedded Applications", Kluwer Academic, 1995.
2. Charles Crowley, "Operating systems-A design oriented approach", Mc Graw Hill.
3. Operating System Principles, Abraham Silberchatz, PeterB.Galvin, Greg Gagne 8th Edition, Wiley Student Edition.
4. Real Time Concepts for Embedded Systems–Qing Li, Elsevier, 2011

REFERENCE BOOKS

1. RAJBUHR, DL Beily,"An introduction to realt ime systems", PHI,1999.
2. CM Krishna, Kang G. Shin, "Real time Systems", McGraw Hill, 1997.
3. Raymond J.A., DonaldL Baily, "An introduction to real time operating systems", PHI 1999.

Course Code	System On Chip	L	T	P	C
BM4V52		3	0	0	3

COURSE OBJECTIVES:

- To introduce architecture and design concepts underlying system on chips.
- Students can gain knowledge of designing SoCs.
- To impart knowledge about the hardware-software design of a modest complexity chipall the way from specifications, modeling, synthesis and physical design.

UNIT I System Architecture: Overview **9**

Components of the system– Processor architectures –Memory and addressing – system level interconnection – SoC design requirements and specifications – design integration – design complexity – cycle time, die area and cost, ideal and practical scaling, area-time-power tradeoff in processor design, Configurability.

UNIT II Processor Selection for SOC **9**

Overview–soft processors, processor core selection. Basic concepts –instruction set, branches, interrupts and exceptions. Basic elements in instruction handling–Minimizing pipeline delays–reducing the cost of branches – Robust processors – Vector processors, VLIW processors, Super scalar processors.

UNIT III Memory Design **9**

SoC external memory, SoC internal memory, Scratch pads and cache memory – cache organization and write policies–strategies for line replacement at misstime–split I-and Dcaches–multi level caches–SoC memory systems – board based memory systems – simple processor/memory interaction.

UNIT IV Inter Connect Architectures & SoC Customization **9**

Bus architectures – SoC standard buses – AMBA, Core Connect – Processor customization approaches – Reconfigurable technologies – mapping designs onto reconfigurable devices - FPGA based design – Architecture of FPGA, FPGA interconnect technology, FPGA memory, Floor plan and routing.

UNIT V FPGA Based Embedded Processor **9**

Hardware software task partitioning–FPGA fabric Immersed Processors–Soft Processors and Hard Processors –Tool flow for Hardware/Software Co-design–Interfacing Processor with memory and peripherals –Types of On-chip interfaces – Wishbone interface, Avalon Switch Matrix, OPB Bus Interface, Creating a Customized Microcontroller - FPGA-based Signal Interfacing and Conditioning.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: At the end of the course, students will demonstrate the following specific abilities:

CO1: Systems Understanding and SoC Design Trade offs
CO2: Processor Selection Proficiency for SoC Applications
CO3: Expertise in SoC Memory System Design
CO4: Understanding Various Bus Architectures and SoC Customization
CO5: Mastery in FPGA-Based Embedded Processor Development

TEXT BOOKS

1. "Digital Integrated Circuits: A Design Perspective "by Jan M.Rabaey, Anantha Chandrakasan, and Borivoje Nikolić
2. "Computer Organization and Design: The Hardware/Software Interface" by David A. Patterson and JohnL. Hennessy

REFERENCE BOOKS

1. Michael J.Flynnand Wayne Luk, “Computer System Design: System-on-Chip”, John Wiley and sons, 2011.
2. Rahul Dubey, “Introduction to Embedded System Design Using Field Programmable Gate Arrays”, Springer Verlag London Ltd., 2009.
3. Sudeep Pasricha and Nikil Dutt, On-Chip Communication Architectures- System on Chip Interconnect, Elsevier, 2008.

Course Code	FPGA and VLSI Design	L	T	P	C
BM4V53		3	0	0	3

COURSE OBJECTIVES:

- To understand the FPGA programming, architectures and applications
- To Study the fundamentals of SRAM programming technologies and architectures.
- To Study the fundamentals of CMOS circuits and its characteristics
- Learn the design and realization of combinational & sequential digital circuits.
- Learn the design and realization of sequential digital circuits.

UNIT I Field Programmable Gate Arrays **9**

Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, Applications of FPGAs.

UNIT II SRAM Programmable FPGAS **9**

Introduction, Programming Technology, Device Architecture, The Xilinx XC2000, XC3000 and XC4000 Architectures.

UNIT III MOS Transistor Theory **9**

Basic MOS transistors: Symbols, Enhancement mode, Depletion mode transistor operation - Regions of operation, Second order effects of MOSFET, MOS Scaling, Fundamental limits of MOS scaling, CMOS inverter: DC Characteristics, Power dissipation.

UNIT IV Combinational CMOS Logic Circuits **9**

MOS logic circuits with depletion nMOS loads, CMOS logic circuits, complex logic circuits, CMOS transmission gates (pass gates), ratioed, dynamic and pass transistor logic circuits

UNIT V Sequential CMOS Logic Circuits **9**

Behaviour of bi-stable elements, SR latch circuits, clocked latch and flip-flop circuits, CMOS D-latch and edge-triggered flip-flop. Timing path, Setup time and hold time static, example of setup and hold time static, setup and hold slack, clock skew and jitter, Clock, reset and power distributions.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon Completion of the course the students will be able to

CO1: Analyze the FPGA architecture and do some applications
CO2: Analyze various programming technologies and architecture used in SRAM FPGAs.
CO3: Design MOS circuits and analyze the factors influencing the operation of CMOS transistors.
CO4: Design combinational MOS circuits and power strategies
CO5: Design and construct Sequential Circuits and Timing systems.

TEXT BOOKS:

1. Field Programmable Gate Array Technology - Stephen M. Trimberger, Springer International Edition.
2. Neil H.E. Weste, David Money Harris —CMOS VLSI Design: A Circuits and Systems Perspective||, 4th Edition, Pearson, 2017.
3. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, ||Digital Integrated Circuits: A Design perspective||, Second Edition , Pearson , 2016.

REFERENCE BOOKS:

1. Field Programmable Gate Arrays - John V. Oldfield, Richard C. Dorf, Wiley India
2. FPGA based System Design - Wayne Wolf, Prentice Hall Modern Semiconductor Design Series.
3. John P.Uyemura, Introduction to VLSI circuits and systems, John Wiley, 2016.
4. Kamran Eshraghian, Douglas A. Pucknell, Essentials of VLSI Circuits and Systems Prentice Hall of India, 2015.
5. Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata McGraw Hill, 2014.
6. B.P.Lathi, —Modern Digital and Analog Communication Systems|| 3rd Edition, Oxford University Press 2007.
7. Abramovici .M, Breuer M.A and Friedman A.D, Digital Systems and Testable Design, Jaico Publishing House, 2002.

Course Code	**Embedded Processor**	L	T	P	C
BM4V54		3	0	0	3

COURSE OBJECTIVES:

- Learn the architecture and features of ARM.
- Study the exception handling and interrupts in CORTEX M3
- Program the CORTEX M3
- Learn the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller.
- Understand the concepts of advanced processor

UNIT I Overview of Arm and Cortex-M3 **9**

ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence , CORTEX M3 Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions, CORTEX M3 – Implementation Overview: Pipeline, Block Diagram. Bus Interfaces, I –Code Bus, D – Code Bus, System Bus- External PPB and DAP Bus.

UNIT II Cortex Exception Handling and Interrupts **9**

Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Overview, Basic Interrupts, SYSTICK Time, Interrupt Behaviourm Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency.

UNIT III Cortex M3/M4 Programming **9**

Cortex M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS Using Assembly, Exception Programming Using Interrupts, Exception/Interrupt Handlers, Software

Interrupts, Vector Table Relocation, Memory Protection Unit and other CORTEX M3 Features, MPU Registers, Setting up the MPU, Power Management, Multiprocessor Configuration.

UNIT IV STM32L15XXX Arm Cortex M3/M4 Microcontroller and Debugging Tools 9

STM32L15XXX ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control, STM32L15XXX Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART Development and Debugging Tools: Software and Hardware tools like Cross Assemblerm Compiler, Debugger, Simulator, In – Circuit Emulator (ICE), Logic Analyser.

UNIT V Application 9

–AES, 3D Graphics Processor. Image Compression and Video Compression.

TOTAL PERIODS :45

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Explain the architecture and features of ARM.
CO2: List the concepts of exception handling.
CO3: Write a program using ARM CORTEX M3/M4.
CO4: Learn the architecture of STM32L15XXX ARM CORTEX M3/M4.
CO5: Design for any application.

TEXT CUM REFERENCE BOOKS

1. Joseph Yiu, The Definitive Guide to the ARM CORTEX M3/M4, Second Edition, Elsevier, 2010. (Unit – I, II)
2. Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developers Guide Designing and Optimising System Software, Elsevier, 2006 (Unit – III, IV)
3. Michael J Flynn and Wayne Luk, Computer System Design, System On Chip, Wiley India 2011. (Unit – V)

Course Code	**Computer Vision And Advanced Image Processing**	L	T	P	C
BM4V55		3	0	0	3

COURSE OBJECTIVES:

- To review image processing techniques for computer vision.
- To understand various features and recognition techniques
- To learn about histogram and binary vision
- Apply three-dimensional image analysis techniques
- Study real world applications of computer vision algorithms

UNIT I Introduction **9**

Computer Vision, What is Computer Vision - Low-level, Mid-level, High-level ; Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective

UNIT II Feature Extraction **9**

Feature Extraction -Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space 69 Analysis-Image Pyramids and Gaussian derivative filters, Gabor Filters.

UNIT III Color Images, Binary Vision **9**

Simple pinhole camera model – Sampling – Quantisation – Colour images – Noise – Smoothing – 1D and 3D histograms- Back-projection - k-means Clustering – Thresholding - Threshold Detection Methods - Variations on Thresholding - Mathematical Morphology – Connectivity.

UNIT IV 3D Vision **9**

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction

UNIT V Motion **9**

Introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion–spline-based motion- optical flow – layered motion.

Total:45 Periods

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Enumerate low level processing of image and transformation techniques applied to images.
CO2: Devlope the feature extraction and object recognition methods
CO3: Apply Histogram transform for detection of geometric shapes like line, ellipse and objects.
CO4: Illustrate 3D vision process and motion estimation techniques.
CO5: Apply vision techniques to real time applications.

TOTAL:60 PERIODS

TEXT BOOKS

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited, 2011
2. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012

3. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003

REFERENCES

1. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.
2. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.
3. Concise Computer Vision: An Introduction into Theory and Algorithms, by Reinhard Klette, 2014.

Course Code	**Advanced Signal Processing**	L	T	P	C
BM4V56		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To study the characteristics of different biosignals
- To learn linear and non-linear filtering techniques to extract desired information
- To understand various techniques for automated classification and decision making to aid diagnosis.

UNIT I Biosignal and Spectral Characteristics

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT II Time Series Analysis and Spectral Estimation

Time series analysis – linear prediction models, process order estimation, lattice representation, non-stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation –Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

UNIT III Adaptive Filtering and Wavelet Detection

Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in ECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV Biosignal Classification and Recognition

Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.

UNIT V Time Frequency and Multivariate Analysis

Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG

characterization, Feature extraction- Wavelet packets, Multivariate component analysis - PCA, ICA.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Preprocess the Biosignals.
CO2: Analyze biosignals in time domain & to estimate the spectrum.
CO3: Apply wavelet detection techniques for biosignal processing.
CO4: Classify Biosignals using neural networks and statistical classifiers.
CO5: Extract the features using multivariate component analysis.

TEXT BOOKS:

1. Rangaraj M. Rangayyan, "Biomedical Signal Analysis-A case study approach", Wiley, 2nd Edition, 2016.
2. Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India, New Delhi, 2003.
3. Arnon Cohen, "Bio-Medical Signal Processing Vol I and Vol II", CRC Press Inc., Boca Rato, Florida, 1999.

REFERENCES:

1. Kayvan Najarian and Robert Splerstor, "Biomedical signals and Image processing'', CRC – Taylor and Francis, New York, 2nd Edition, 2012.
2. K.P.Soman, K.Ramachandran, "Insight into wavelet from theory to practice", PHI, New Delhi, 3rd Edition, 2010.
3. D.C.Reddy, "Biomedical Signal Processing – Principles and Techniques'', Tata McGraw-Hill Publishing Co. Ltd, 2005.
4. John L.Semmlow, "Biosignal and Biomedical Image Processing Matlab Based applications'', Taylor& Francis Inc, 2004

Course Code	**Image Retrieval and Medical Compression Techniques**	L	T	P	C
BM4V57		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Discuss digital image fundamentals
- Examine image enhancement techniques in medical images

- Execute restoration and segmentation techniques in medical images
- Demonstrate the image wavelet and compression Techniques in medical images.
- Describe the representations of features

UNIT I Spatial Domain Processing **9**

Introduction, Steps in Digital Image Processing -Components –Elements of Visual Perception - Image Sensing and Acquisition - Image Sampling and Quantization -Relationships between pixels - color models- DICOM, Various modalities of Medical Imaging-CT, MRI, PET, Thermography, Angiography, CAD System, Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering.

UNIT II Frequency Domain Processing **9**

Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters. Notch filter, Wavelets -Sub band coding-Multi resolution expansions Wavelets based image processing

UNIT III Medical Image Restoration and Segmentation **9**

Image Restoration - Inverse Filtering – Wiener filtering. Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation- Region Growing, Region Splitting, Morphological processing- erosion and dilation, K Means and Fuzzy Clustering.

UNIT IV Medical Image Compression **9**

Image Compression models – Error Free Compression – Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – Compression Standards -JPEG, JPEG2000.

UNIT V Medical Image Representation and Recognition **9**

Boundary representation - Chain Code- Polygonal approximation, signature, boundary segments -Boundary description –Shape number -Fourier Descriptor, moments- Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching, Content Based Image Retrieval. Analysis of Tissue Structure.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Demonstrate the principles of biometric systems..
CO2: Develop fingerprint recognition technique.
CO3: Design face recognition and hand geometry system
CO4: Design iris recognition system
CO5: Develop speech recognition and multimodal biometric systems

TEXT BOOKS:

1. G.R. Sinha, Bhagwaticharan patel, Medical Image Processing: Concepts and Applications, PHI Learning private limited.2014
2. Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2005.
3. E. R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.

REFERENCE:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata McGraw Hill Pvt. Ltd., 2011.
2. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011.
3. William K Pratt, “Digital Image Processing”, John Willey, 2002.
4. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd., 2011.
5. Geoff Dougherty, Medical Image Processing: Techniques and Applications, Springer Science & Business Media, 25-Jul-2011

Course Code	**Augmented Reality And Virtual Reality**	L	T	P	C
BM4V58		3	0	0	3

COURSE OBJECTIVES:

The students should be made**:**

- To study about Fundamental Concept and Components of Virtual Reality
- To study about Interactive Techniques in Virtual Reality
- To study about Visual Computation in Virtual Reality
- To study about Augmented and Mixed Reality and Its Applications.
- To know about I/O Interfaces and its functions.

UNIT I Introduction to Virtual Reality **9**

Introduction, Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark 3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism Stereographic image

UNIT II Interactive Techniques in Virtual Reality **9**

Introduction, from 2D to 3D, 3D spaces curves, 3D boundary representation Geometrical Transformations: Introduction, Frames of reference, Modeling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

UNIT III VR Programming **9**

VR programming-Toolkits and scene graphs-world Toolkit-Java 3D-comparison of world Toolkit And java 3D.

UNIT IV Augmented and Mixed Reality **9**

Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems

UNIT V Augmented Reality **9**

Introduction to augmented reality-computer vision for AR-Interaction-modelling and annotation-navigation-wearable device

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the Fundamental Concept and Components of Virtual Reality
CO2: Able to know the Interactive Techniques in Virtual Reality.
CO3: Can know about Visual Computation in Virtual Reality
CO4: Able to know the concepts of Augmented and Mixed Reality and Its Applications
CO5: Know about I/O Interfaces and its functions.

REFERENCE:

1. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann,First Edition 2013.
3. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.
4. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.
5. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
6. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application and Design”, Morgan Kaufmann, 2008

VERTICAL 6 -DATAANLYTICS

Course Code	Mathematical Fundamentals to Machine Learning	L	T	P	C
BM4V61		3	0	0	3

COURSE OBJECTIVES:

- Understand fundamental linear algebra concepts, including vector spaces, matrices, eigenvalues, and eigenvectors.
- Gain proficiency in advanced calculus techniques, including gradient-based optimization, to train and fine-tune learning models effectively for optimal performance.
- Explore the role of probability and statistics in learning and understanding their significance in model training, uncertainty estimation, and probabilistic modeling.
- Apply mathematical models through hands-on projects, implementing machine learning models.
- Give exposure to the deep learning models and analyze their performance using mathematical tools.

UNIT I Linear Algebra, Matrix, and Analytical Geometry 9

Introduction and Motivation - Linear Algebra, Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces, Analytic Geometry, Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations.

UNIT II Matrix Decomposition and Vector Calculus 9

Matrix Decompositions, Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen-decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Vector Calculus, Differentiation of Univariate, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization, and Multivariate Taylor Series.

UNIT III Probability Distributions and Risk Minimisation 9

Probability and Distributions - Construction of a Probability Space-Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Independence and Gaussian Distribution - Conjugacy and the Exponential Family, Change of Variables/Inverse Transform, Continuous Optimization, Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization. Machine Learning Models, Empirical Risk Minimization, Parameter Estimation, Probabilistic Modelling and Inference, Directed Graphical Models, Model Selection.

UNIT IV Machine Learning Models and Applications 9

Linear Regression, Parameter Estimation, Dimensionality Reduction with Principal Component Analysis, Maximum Variance Perspective, PCA in High Dimensions, Latent Variable Perspective, EM Algorithm, Latent-Variable, Classification with Support Vector Machines.

UNIT V Deep Learning Models **9**

Tensors from Machine Learning and Data Science, Deep Convolutional Neural Network Architectures for Image Classification, Latent Space and Generative Modelling, Autoencoders and Variational Autoencoders.

TOTAL NUMBER OF PERIODS : 45

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: To understand fundamental linear algebra concepts, including vector spaces, matrices, eigenvalues, and eigenvectors.
CO2: To gain proficiency in advanced calculus techniques, including gradient-based optimization, to train and fine-tune learning models effectively for optimal performance.
CO3: Explore the role of probability and statistics in learning and understanding their significance in model training, uncertainty estimation, and probabilistic modelling.
CO4: To apply mathematical models through hands-on projects, implementing machine learning models.
CO5: To explore implementing deep learning models and analyse their performance using mathematical tools.

TEXTBOOKS:

1. Eugene Charniak, “Introduction to Deep Learning," MIT Press, 2018.
2. Ivan Vasilev, Daniel Slater, Gianmario Spacagna, Peter Roelants, Valentino Zocca, “Python Deep Learning," Packt Publishing Ltd, 2019.

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “ Deep Learning," MIT Press, 2017.
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach" O'Reilly Media, 2017.
3. Umberto Michelucci “Applied Deep Learning: A Case-based Approach to Understanding Deep Neural Networks” Apress, 2018.
4. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective" The MIT Press, 2012.
5. EthemAlpaydin,"Introduction to Machine Learning," MIT Press, Prentice Hall of India, Third Edition 2014.
6. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy, "Deep Learning with TensorFlow: Explore Neural Networks with Python" Packt Publisher, 2017.
7. Antonio Gulli, Sujit Pal, "Deep Learning with Keras" Packt Publishers, 2017.
8. Francois Chollet, "Deep Learning with Python," Manning Publications, 2017

Course Code	**Natural Language Processing**	L	T	P	C
BM4V62		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I Introduction to Natural Language Processing **9**

Overview of NLP and its applications-Basics of linguistics and language structure-Challenges in natural language understanding-Tokenization, stemming, and lemmatization-Introduction to language models

UNIT II Text Processing and Information Retrieval **9**

Preprocessing techniques for text data-Information retrieval and document similarity-Text classification and sentiment analysis-Named Entity Recognition (NER) and part-of-speech tagging-TF-IDF and vector space models

UNIT III Syntax and Grammar in NLP **9**

Syntax and grammatical structures in natural language-Dependency parsing and constituency parsing-Grammar formalisms and parsing algorithms-Role of syntax in machine translation-Syntax-based applications in NLP.

UNIT IV Statistical and Machine Learning Approaches in NLP **9**

Introduction to statistical language models-Supervised and unsupervised machine learning for NLP-Word embeddings and distributional semantics-Sequence-to-sequence models for language generation-Neural network architectures in NLP (e.g., recurrent and transformer models)

UNIT V Advanced Topics and Applications in NLP **9**

Coreference resolution and discourse analysis-Question answering systems and dialogue systems-Sentiment analysis in social media-Ethical considerations in NLP, bias, and fairness-Emerging trends in NLP research and applications.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon successful completion of the course, students will be able to

CO1: Describe the concepts of wearable system
CO2: Explain the energy harvestings in wearable device
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile.
CO5: Compare the various wearable devices in healthcare system

TEXT BOOKS

1. "Speech and Language Processing" by Dan Jurafsky and James H. Martin
2. Natural Language Processing in Action" by Lane, Howard, and Hapke

REFERENCES

1. "Attention is All You Need" by Vaswani et al. (2017)
2. "BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding" by Devlin et al. (2018)

Course Code	Edge Computing	L	T	P	C
BM4V63		3	0	0	3

COURSE OBJECTIVES:

- To enhance real-time data processing and analytics at the network edge.
- To optimize resource utilization and reduce latency in fog computing environments.
- To improve scalability and flexibility for edge devices and applications.
- To Enhance security and privacy for data processing at the edge.
- To Facilitate seamless integration of fog and edge computing with cloud services.

UNIT I Introduction to Fog and Edge Computing **9**

Definition and Fundamentals: Overview of Fog and Edge Computing, Key concepts and characteristics, Motivations and Advantages: Reasons for adopting Fog and Edge Computing, Comparative advantages over traditional Cloud Computing, Use Cases and Applications: Challenges and Limitations: Security concerns, privacy issues, and compliance, Comparison with Cloud Computing: Contrasting characteristics and use cases, Complementary roles in a hybrid computing environment

UNIT II Architectures and Components **9**

Edge Computing Architecture Models: Design principles and characteristics, Hierarchical vs. flat architectures. Fog Nodes and Infrastructure: Role and capabilities of Fog nodes, Infrastructure components supporting Edge Computing. Edge Device Types and Capabilities: Categorization of Edge devices (e.g., gateways, sensors, actuators), Capabilities and limitations of different device types. Edge-to-Cloud Communication Models; Middleware and Software Frameworks: Middleware solutions for Edge Computing.

UNIT III Security and Privacy in Edge Computing **9**

Need for automata theory - Introduction to formal proof – Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Equivalence between NFA and DFA – Finite Automata with Epsilon transitions – Equivalence of NFA and DFA- Equivalence of NFAs with and without ε-moves- Conversion of NFA into DFA – Minimization of DFAs.

UNIT IV Edge Application Development **9**

Programming Models and Frameworks: Overview of programming models for Edge Computing, Exploration of popular frameworks for Edge application development, Integration with IoT Devices:

Techniques for integrating Edge Computing with Internet of Things (IoT) devices. Edge Application Deployment Strategies; Edge-to-Cloud Communication Patterns; Optimizing Edge Application Performance: Performance considerations in Edge Computing, Strategies for optimizing resource usage and responsiveness.

UNIT VPerformance Optimization and Future Trends **9**

Performance Metrics and Optimization: Metrics for evaluating performance in Edge Computing Strategies for optimizing Edge applications; Energy-Efficient Edge Architectures: Techniques for optimizing energy consumption, Green computing practices in Edge environments, Real-time Processing and Analytics: Approaches for real-time data processing at the Edge, Analytics

capabilities in decentralized architectures. Scalability and Flexibility in Edge Architectures; Emerging Trends in Fog and Edge Computing.

NO. OF THEORY PERIODS : 45

SAMPLE LIST OF EXPERIMENTS

1. Design and deploy a fog computing architecture for a smart city application.
2. Optimize data processing algorithms for edge devices in a real-time monitoring system.
3. Evaluate resource utilization in a fog computing environment using simulation tools.
4. Implement security protocols for edge devices to protect sensitive data.
5. Develop a scalable edge computing solution for IoT devices in a manufacturing setting.
6. Integrate fog computing with cloud services to enhance overall system efficiency.
7. Perform a hands-on deployment of edge computing nodes in a network infrastructure.
8. Design and implement a fault-tolerant edge computing solution for critical applications.
9. Conduct performance testing to assess the latency reduction achieved through edge computing.
10. Create a comprehensive case study on the successful integration of fog and edge computing in a specific industry.

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Proficiently deploy and manage fog and edge computing solutions in diverse environments.
CO2: Demonstrate expertise in optimizing data processing and analytics at the network edge.
CO3: Evaluate and enhance resource efficiency for fog computing deployments.
CO4: Implement robust security measures for safeguarding edge computing data.
CO5: Successfully integrate fog and edge computing technologies to address real-world challenges.

REFERENCES:

1. "Fog and Edge Computing: Principles and Paradigms" by Rajkumar Buyya and Amir Vahid Dastjerdi (Wiley, 1st Edition, 2018),
2. "Edge Computing: A Primer" by Shiwen Mao and Ying-Chang Liang (Wiley, 1st Edition, 2019),
3. "Fog Computing in the Internet of Things: Intelligence at the Edge" by Yogesh Simmhan, Nalini Venkatasubramanian, and Viktor K. Prasanna (Springer, 1st Edition, 2018),
4. "Fog Computing: Concepts, Frameworks and Technologies" by Flavio Bonomi, Rodolfo Milito,
5. Jiang Zhu, and Sateesh Addepalli (Springer, 1st Edition, 2018),
6. "Edge Computing – The Dawn of Industry 4.0 Revolution" by Satya Prakash Ghrera (CRC Press, 1st Edition, 2020)

7. "Fog Computing: Towards Minimizing Latency and Improving QoE in the Internet of Things" by Mohammad Mehedi Hassan, Saad B. Qaisar, and Abdelgadir Mohammed Ahmed (Springer, 1st Edition, 2018).

Course Code	**Deep Learning Technique**	L	T	P	C
BM4V64		3	0	0	3

UNIT I Basics of Neural Network **9**

Artificial Neuron - McCulloch Pitts units and Thresholding logic - Perceptron learning algorithm and Convergence - Linear separability - Feedforward Networks - Activation and Loss Functions.

Suggested Activities

- Implement a perceptron learning algorithm
- Design an artificial neural using thresholding logic and other activation functions
- Analyze convergence of feed forward networks

Suggested Evaluation Methods

- Coding challenges to complete during class
- Assignment to implement and train the network using appropriate technique and tools
- Quizzes and test

UNIT II Introduction of Deep Neural Networks **9**

Multilayer perceptron - Gradient Descent(GD) – Backpropagation - Vanishing and Exploding GD problem – Optimization Methods: Stochastic GD: Momentum based GD & Nesterov Accelerated GD, AdaGrad, RMSProp, Adam – Bias Variance tradeoff - Regularization – Dropout.

Suggested Activities:

- Implement a multilayer perceptron
- Experiment with different optimization methods
- Test with regularization techniques

Suggested Evaluation Methods:

- Coding Assignments – Vanishing and Exploding GD
- Tutorial on Multilayer perceptron and optimization methods
- Quizzes Regularization – Dropout

UNIT III Convolutional Neural Networks **9**

Motivation – Architectural Overview –Pooling – Parameter sharing - Regularization -Popular CNN Architectures: ResNet, AlexNet, VGGNet - Transfer learning –Image classification using Transfer learning.

Suggested Activities:

- Flipped classroom on CNN architectures
- External learning – concept of convolution and pooling layer
- Exploring on Transfer learning

Suggested Evaluation Methods:

- Quizzes on CNN architectures
- Hands-on coding Assignments on image classification using transfer learning

UNIT IV Recurrent Neural Networks **9**

Sequence Modelling –Recurrent Neural Networks, Bidirectional RNNs – Encoder-decoder sequence to sequence architectures - Deep Recurrent Networks, Recursive Neural Networks - Long Short-Term Memory Networks – Other Gated RNNs

Suggested Activities:

- Implement and train a simple RNN
- Build a sequence-to-sequence model
- Use a pretrain RNN model and analyse their performance on different sequence modelling task.
- Implement an LSTM network.

Suggested Evaluation Methods:

- Evaluate the accuracy of the RNN models prediction on a test dataset
- Comparison of architectures: LSTM, GRU, RNN on a test dataset

UNIT V Autoencoders and Generative Models **9**

Autoencoders – Regularized Autoencoders – stochastic Encoders and Decoders – Contractive Encoders - Deep Belief networks – Boltzmann Machines – Deep Boltzmann Machine – Directed Generative Nets - Generative Adversarial Networks

Suggested Activities:

- Discussion on Building and training autoencoders
- Understand the math behind the generative models

Suggested Evaluation Methods:

- Assignment problems on Directed Generative nets and Generative adversarial networks
- Quizzes on autoencoders

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Understand fundamental neural network concepts, including activation functions and loss functions.
CO2: Familiarize with different optimizers in machine learning and choose the appropriate one.

CO3: Design and implement deep learning architectures, such as CNNs, RNNs, autoencoders and Generative models.
CO4: Implement deep learning models using libraries like TensorFlow or PyTorch.
CO5: Apply deep learning techniques to real-world problems, with awareness of ethical considerations.

TEXT BOOKS

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, " Deep Learning", MIT Press, 2017.
2. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.

REFERENCES

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.
3. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012.
4. Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.
5. Francois Chollet, "Deep Learning with Python", Manning Publications, 2018.

Course Code	**Generative AI**	L	T	P	C
BM4V65		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To know various generative ai techniques
- To explore the tools required
- To know the methods to implement

UNIT I Fundamentals of Generative AI **9**

Defining AI, ML, DL, LLM and Generative Models Learning Supervised and Unsupervised ML Tasks -Generative and Discriminative AI -Generative AI A Peek into Generative Models Deconstructing the Behavior of Large Language Models ML, DL and Generative AI Applications in Business Hands-on Demonstration of Popular Tools (ChatGPT, DALL-E, BLIP)

UNIT II Fundamental Principles of Machine Learning on Azure **9**

Understanding principles for responsible AI, and gaining familiarity with common machine learning techniques. Identify features of common AI workloads Identify guiding principles for responsible AI Identify common machine learning techniques Describe core machine learning concepts Describe Azure machine learning capabilities.

UNIT III AI900: AZURE AI Fundamentals **9**

Foundational understanding of machine learning, AI concepts, and associated Microsoft Azure services. While Azure AI fundamentals can be beneficial in preparing for Azure role-based certifications such as Azure Data Scientist Associate or Azure AI Engineer Associate, computer vision solution types and discover Azure tools f- handling computer vision tasks. -Identify features of typical NLP workload scenarios and explore Azure tools and services applicable to NLP workloads.

UNIT IV Leveraging Generative AI for Business Applications **9**

Understanding Generative AI, exploring Azure OpenAI services, mastering prompt engineering. AI, Machine Learning (ML), Deep Learning (DL), Large Language Models (LLMs), applications across various industries. Azure OpenAI services.

UNIT V Designing Generative AI Solutions -Azure Open AI **9**

Generative AI applications at scale using Python. Azure Open AI API key the Python library/SDK to work with various Generative AI models. Completions API, Chat Completions API, and Embeddings API, understanding their rates, limits, and pricing. Practical applications of Generative AI in text classification, summarization, classifying medical records , assigning themes to finance news articles

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

CO1: Understand the fundamentals of exploratory generative AI
CO2: Apply concepts in Machine learning on azura.
CO3: Perform analysis using azura
CO4: Interpret results of generative AI in business application
CO5: Implement designing of generative AI

TEXT BOOKS:

1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”,Packt Publishing, 2020.
2. Thomas Cleff, “Exploratory Data Analysis in Business and Economics”, Springer International, 2013.
3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly Media, 1st Edition, December 2016.
4. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

REFERENCES:

1. Glenn J. Myatt, Wayne P. Johnson,” Making Sense Of Data I”, John Wiley & Sons, 2nd Edition, 2014.
2. Glenn J. Myatt, Wayne P. Johnson,” Making Sense Of Data Ii”, John Wiley & Sons, 2nd Edition, 2009.

Course Code	Data Exploration and Data Visualisation	L	T	P	C
BM4V66		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To know various data analysis techniques
- To explore the data available
- To know the methods to analyse the data

UNIT I The Fundamentals of EDA **9**

The Fundamentals of EDA – Identifying Data quality – Missing values – Irregular Cardinality – Outliers – handling data Quality - Describing Data, Preparing Data Tables, Understanding Relationships - Identifying and Understanding Groups, Building Models from Data.

Suggested activities:

1. Explore your dataset
2. Extract important variables and leave useless variables
3. Identify outliers, missing values, or human error

Suggested Evaluation Methods:

1. Assignments on exploratory data analysis

UNIT II Exploratory Data Analysis **9**

Significance of EDA - Comparing EDA with classical and Bayesian analysis - Software tools for EDA - Visual Aids for EDA - EDA with Personal Email - Data Transformation - Descriptive Statistics - Grouping Datasets Correlation - Time Series Analysis.

Suggested activities:

1. Identify the relationship(s), or lack of, between variables
2. Discover patterns and Use correlation analysis to identify linear relationships between two variables

Suggested Evaluation Methods:

1. Creating an application and exploring real time analysis

UNIT III Univariate, Bivariate, Multivariate Data Analysis **9**

Univariate Data Analysis - Bivariate Association - Regression Analysis - Cluster Analysis - Visualization Design Principles – Tables - Univariate Data Visualization - Bivariate Data Visualization - Multivariate Data Visualization - Visualizing Groups - Dynamic Techniques.

Suggested activities:

1. Practice using the qnorm function.

Given a normal distribution with mean 650 and standard deviation 125. There exist two quantiles, the lower quantile q1 and the upper quantile q2, that are equidistant from the mean 650, such that the area under the curve of the normal between q1 and q2 is 80%. Find q1 and q2.

Calculate the mean, variance, and the lower quantile q1 and the upper quantile q2, that are equidistant and such that the range of probability between them is 80%.

2. Combine two of the techniques you've learned to visualise the combined distribution of cut, carat, and price.

Suggested Evaluation Methods:

1. Creating an application and understanding different data visualization.
2. Assignments of the problem

UNIT IV Data Visualization (2D / 3D) 9

Simple Line Plots - Simple Scatter Plots - Visualizing Errors - Density and Contour Plots - Histograms, Binnings, and Density - Customizing Plot Legends - Customizing Colorbars - Multiple Subplots - Text and Annotation - Customizing Ticks - Customizing Stylesheets - Three-Dimensional Plots - Geographic Data with Basemap - Visualization with Seaborn.

Suggested activities:

1. Scatter Plot with Matplotlib
2. Histogram with Plotnine (ggplot)
3. Boxplot with Seaborn

Suggested Evaluation Methods:

1. Understanding 2D/3D data visualization with an application by a developmental model
2. Assignments of the problem

UNIT V Interactive Data Visualization 9

Text and Document Visualization - Levels of Text Representations -Single Document Visualizations - Document Collection Visualizations- Interaction Concepts and Techniques - Designing Effective Visualizations - Comparing and Evaluating Visualization Techniques - Visualization Systems - Systems based on Data Type - Systems based on Analysis Type - Text Analysis and Visualization - Modern Integrated Visualization Systems

Suggested activities:

1. Emphasizing Fractions Using a Pie Chart
2. Plotting X/Y Data with a Scatter Chart
3. Add Magnitudes to X/Y Data with a Bubble Chart
4. Add Controls and Define data Structure for Interactive Charts
5. Integrate Charts to a web page and establish default style for the charts
6. Draw Composite charts and handle click events
7. Create Timeline chart
8. Visualize the Geographic data, incorporate label animation

Suggested Evaluation Methods:

1. Creating an interactive data visualization in a web page.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

CO1: Understand the fundamentals of exploratory data analysis and its commonly used techniques.
CO2: Apply statistical concepts to analyze data and explore the tools used for EDA.
CO3: Perform multivariate data visualization and analysis.
CO4: Interpret results of exploratory data analysis using stylesheets
CO5: Implement visualization techniques in web for applications

TEXT BOOKS:

1. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020.
2. Thomas Cleff, "Exploratory Data Analysis in Business and Economics", Springer International, 2013.
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 1st Edition, December 2016.
4. Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.

REFERENCES:

1. Glenn J. Myatt, Wayne P. Johnson," Making Sense Of Data I", John Wiley & Sons, 2nd Edition, 2014.
2. Glenn J. Myatt, Wayne P. Johnson," Making Sense Of Data Ii", John Wiley & Sons, 2nd Edition, 2009.

Course Code	**Text and Speech Analytics**	L	T	P	C
BM4V67		3	0	0	3

COURSE OBJECTIVES:

The students should be made**:**

- Understand natural language processing basics
- Apply classification algorithms to text documents
- Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

UNIT I Natural Language Basics **9**

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop- words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model.

Suggested Activities

- Flipped classroom on NLP
- Implementation of Text Preprocessing using NLTK
- Implementation of TF-IDF models.

Suggested Evaluation Methods

- Quiz on NLP Basics
- Demonstration of Programs

UNIT II Text Classification **9**

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models.

Suggested Activities

- Flipped classroom on Feature extraction of documents
- Implementation of SVM models for text classification
- External learning: Text summarization and Topic models

Suggested Evaluation Methods

- Assignment on above topics
- Quiz on RNN, Transformers
- Implementing NLP with RNN and Transformers

UNIT III Question Answering and Dialogue Systems **9**

Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems

Suggested Activities:

- Flipped classroom on language models for QA
- Developing a knowledge-based question-answering system
- Classic QA model development

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on knowledge-based question answering system
- Development of simple chatbots

UNIT IV Text-To-Speech Synthesis **9**

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems

Suggested Activities:

- Flipped classroom on Speech signal processing
- Exploring Text normalization
- Data collection
- Implementation of TTS systems

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on wavenet, deep learning-based TTS systems
- Finding accuracy with different TTS systems

UNIT V Ethics, Privacy and Social Implications **9**

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

Suggested Activities:

- Flipped classroom on Speech recognition.
- Exploring Feature extraction

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on acoustic modelling

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Understand the existing and emerging deep learning architectures for text and speech
CO2: Apply deep learning techniques for NLP tasks, language modelling and machine translation
CO3: Detail study on coreference and coherence for text processing
CO4: Build question-answering systems, chatbots and dialogue systems
CO5: Apply deep learning models for building speech recognition and text-to-speech systems

TEXT BOOKS

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition, 2022.

REFERENCES

1. Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress, 2018.
2. Tanveer Siddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.
4. Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”, O’REILLY

Course Code	Robotics in Medicine	L	T	P	C
BM4V68		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Get introduced to the fundamental of robotics and position analysis
- Learn about Parallel robots, different types of motions and force analysis
- Know the basics of trajectory planning, Motion control systems and actuators
- Have an insight into various sensors and vision systems
- Be acquainted to Fuzzy control and Applications of Robotics in Medicine

UNIT I Fundamentals and Position Analysis **9**

Fundamentals – Classification, Advantages and disadvantages, Components, Degrees of freedom, Joints, Coordinates, Reference frames, Programming modes, Characteristics, Workspace, Languages, Collaborative robots, Position analysis – Robots as mechanisms, Position analysis of Articulated robot

UNIT II Parallel Robots, Differential Motions and Force Analysis **9**

Parallel robots – Physical characteristics, Forward and Inverse Kinematic approaches, Planar and Spatial parallel robots, Differential relationships, The Jacobian, Large scale motions, Frame vs Robot, Differential motions and change, Hand frame, Operator, Jacobian and Inverse for Screw based and Parallel Robots, Differential operator, Lagarangian mechanics, Moments of Inertia, Dynamic Equations of Multiple DOF Robots, Static force analysis, Transformation of forces and moments between coordinate frames

UNIT III Trajectory Planning, Motion Control Systems and Actuators **9**

Path and Trajectory, Joint Space and Cartesian Space Descriptions and Trajectory Planning, Cartesian, Trajectory Recording, Basics, Block diagrams, Laplace Transform, Block diagram Algebra, Transfer Functions, Characteristic equation, Steady state error, Root locus, Proportional, Integral and Derivative controllers, Compensators, Bode, Loops, Multiple IO systems, Control - State space and Digital, Nonlinear systems, Characteristics of Hydraulic, Pneumatic, Electric motors, Other actuators, Speed reduction

UNIT IV Sensors, Image Processing and Analysis with Vision Systems **9**

Sensor Characteristics, Position, Velocity, Acceleration, Force, Pressure and Torque, Microswitches, Visible and IR, Touch, Proximity, Range finders, Sniff, Vision, Transforms – Fourier, Hough, Resolution, Quantization, Sampling, Image processing, Segmentation, Region growing and splitting, Operations, Object recognition, Depth, Specialized lighting, Compression, Colour images, Heuristics,

UNIT V Fuzzy Control and Applications in Medicine **9**

Fuzzy control - Crisp vs Fuzzy, Sets, Inference rules, Defuzzification, Simulation, Applications in Biomedical Engineering, Applications in rehabilitation, Nanobots in medicine, Clinical diagnosis and Surgery – Cardiac and abdominal procedures with teleoperated robots, Orthopedic surgery with cooperative robots

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon successful completion of the course, students will be able to

CO1: Describe the fundamental of robotics and position analysis
CO2: Outline the functioning of parallel robots, different types of motions and force analysis.
CO3: Portray the basics of trajectory planning, Motion control systems and actuators.
CO4: Recognize and explain the use of various sensors and vision systems in robotics.
CO5: Employ Fuzzy control in robotics and apply it to Robotics in Medicine

TEXT BOOKS

1. S. B. Niku, Introduction to Robotics, Analysis, Control, Applications, Pearson Education, 2020
2. Robert Schilling, Fundamentals of Robotics-Analysis and control, Prentice Hall of India, 2003.
3. Fu Gonzales and Lee, Robotics, McGraw Hill, 1987.
4. J Craig, Introduction to Robotics, Pearson Education, 2005.

REFERENCES

1. Grover, Wiess, Nagel and Oderey, Industrial Robotics, McGraw Hill, 2012.
2. Klafter, Chmielewski and Negin, Robot Engineering, Prentice Hall Of India, 1989.
3. Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications, 2003.
4. Bijay K. Ghosh, Ning Xi, T.J. Tarn, Control in Robotics and Automation Sensor – Based integration, Academic Press, 1999.
5. Mikell P. Groover, Mitchell Weiss, Industrial robotics, technology, Programming and Applications, McGraw Hill International Editions, 1986.
6. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Robotic engineering - An Integrated Approach, Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 1989.

VERTICAL 7-FULL STACK DEVELOPMENT

Course Code	Web Development 5.0	L	T	P	C
BM4V71		2	0	2	3

COURSE OBJECTIVES:

- To define the evolution of web development from static websites to modern web applications
- To explore the concepts of components, JSX, and state management.
- To define Node.js and Express.js and their roles in server-side development.
- To integrate databases with web applications.
- To understand various deployment strategies for web applications.

UNIT I Introduction to Modern Web Development **6**

Evolution of Web Development- Historical overview of web development- Introduction to Web Development 5.0 and its characteristics- Modern Web Development Ecosystem- Overview of front-end and back-end technologies- Introduction to popular frameworks and libraries

UNIT II Front-end Development with React.js **6**

Introduction to React.js- Overview of React.js and its key features- Understanding JSX syntax and component-based architecture- Components and State Management- Creating functional and class components- Managing state and props in React applications

UNIT III Back-end Development with Node.js and Express.js **6**

Introduction to Node.js and Express.js- Overview of Node.js and its event-driven architecture- Introduction to Express.js as a web application framework- Building RESTful APIs- Understanding RESTful principles- Creating a simple RESTful API with Express.js

UNIT IV Database Integration and Authentication **6**

Database Integration- Overview of database options (MongoDB, MySQL, etc.)- Integrating MongoDB with Express.js- User Authentication and Authorization- Introduction to authentication and authorization- Implementing user authentication using Passport.js

UNIT V Deployment and Project Work **6**

Deployment Strategies- Traditional Server Hosting- Cloud Hosting- Containerization- Container Orchestration- Serverless Architecture- Continuous Deployment- Blue-Green Deployment- Feature Toggles- Best Practices- Project Work Guidelines- Tips for effective project planning, collaboration, and troubleshooting

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

NUMBER OF PRACTICAL PERIODS: 30

SAMPLE LIST OF EXPERIMENTS

1. Installation and configuration of development tools.
2. Introduction to version control using Git.
3. Creating a basic HTML5 and CSS3 web page.
4. Introduction to responsive design principles.

5. Building a simple React application.
6. Implementing components and managing state.
7. Practical exercises on creating stateful and stateless components.
8. Implementing interactivity in React applications.
9. Creating a basic web server using Node.js.
10. Implementing asynchronous programming with callbacks and Promises.
11. Integration of MongoDB with Express.js.

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Understand and Apply Modern Web Development Concepts.
CO2: Create interactive and dynamic user interfaces with React.js.
CO3: Apply design patterns to new projects and re-factor existing code.
CO4: Implement secure user authentication and authorization using Passport.js.
CO5: Understand various deployment strategies and hosting platforms.

TEXTBOOKS:

1. "Learning React" by Alex Banks and Eve Porcello
2. "Node.js Design Patterns" by Mario Casciaro
3. "The DevOps Handbook" by Gene Kim, Jez Humble, Patrick Debois, and John Willis.

REFERENCES:

1." Express in Action" by Evan Hahn
2. "MongoDB: The Definitive Guide" by Shannon Bradshaw, Eoin Brazil, Kristina Chodorow

Course Code	**APP Development**	L	T	P	C
BM4V72		2	0	2	3

COURSE OBJECTIVES:

- To learn the development of native applications with basic GUI Components
- To develop cross-platform applications with event handling
- To develop applications with location and data storage capabilities
- To develop web applications with database access

UNIT I Fundamentals of Mobile & Web Application Development 6

Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design

UNIT II Native App Development Using Java 6

Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Development Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State, Props

UNIT III Hybrid App Development **6**

Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova

UNIT IV Cross-Platform App Development Using React-Native **6**

What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons ofCross-platform App, Popular Cross- platform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props

UNIT V Non-Functional Characteristics of App Frameworks **6**

Comparison of different Ap p frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

NUMBER OF PRACTICAL PERIODS: 30

SAMPLE LIST OF EXPERIMENTS

1. Using react native, build a cross platform application for a BMI calculator.
2. Build a cross platform application for a simple expense manager which allows entering expenses and income on each day and displays category wise weekly income and expense.
3. Develop a cross platform application to convert units from imperial system to metric system (km to miles, kg to pounds etc.,)
4. Design and develop a cross-platform application for day-to-day task (to-do) management.
5. Design an android application using Cordova for a user login screen with username, password, reset button and a submit button. Also, include header image and a label. Use layout managers.
6. Design and develop an android application using Apache Cordova to find and display the current location of the user.
7. Write programs using Java to create Android application having Databases
    1. For a simple library application.
    2. For displaying books available, books lend, book reservation. Assume that student
    3. Information is available in a database which has been stored in a database server.

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Develop Native applications with GUI Components.
CO2: Develop hybrid applications with basic event handling.
CO3: Implement cross-platform applications with location and data storage capabilities.

TEXTBOOKS:

1. Head First Android Development, Dawn Griffiths, O'Reilly, 1st edition
2. Apache Cordova in Action, Raymond K. Camden, Manning. 2015
3. Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing

REFERENCES:

1. Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition
2. Native Mobile Development by Shaun Lewis, Mike Dunn
3. Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras
4. Apache Cordova 4 Programming, John M Wargo, 2015
5. React Native Cookbook, Daniel Ward, Packt Publishing, 2nd Edition

Course Code	**UI and UX Design**	L	T	P	C
BM4V73		2	0	2	3

COURSE OBJECTIVES:

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design
- To explore the various Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I Foundations of Design **6**

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

UNIT II Foundations of UI Design **6**

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides

UNIT III Foundations of UX Design **6**

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals

UNIT IV Wireframing, Prototyping and Testing **6**

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT V Research, Designing, Ideating, & Information Architecture **6**

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

SAMPLE LIST OF EXPERIMENTS

1. Designing a Responsive layout for an societal application
2. Exploring various UI Interaction Patterns
3. Developing an interface with proper UI Style Guides
4. Developing Wireflow diagram for application using open source software
5. Exploring various open source collaborative interface Platform
6. Hands on Design Thinking Process for a new product
7. Brainstorming feature for proposed product
8. Defining the Look and Feel of the new Project
9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
10. Identify a customer problem to solve
11. Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping
12. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements

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

CO1: Build UI for user Applications
CO2: Evaluate UX design of any product or application
CO3: Demonstrate UX Skills in product development
CO4: Implement Sketching principles
CO5: Create Wireframe and Prototype

TEXTBOOKS:

1. Joel Marsh, “UX for Beginners”, O’Reilly, 2022
2. Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021

REFERENCES:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3rd Edition , O’Reilly 2020
2. Steve Schoger, Adam Wathan “Refactoring UI”, 2018
3. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015

4. https://www.nngroup.com/articles/
5. https://www.interaction-design.org/literature.

Course Code	Cloud Services Management	L	T	P	C
BM4V74		2	0	2	3

COURSE OBJECTIVES:

- Introduce Cloud Service Management terminology, definition & concepts
- Compare and contrast cloud service management with traditional IT service management.
- Identify strategies to reduce risk and eliminate issues associated with the adoption of cloud services.
- Select appropriate structures for designing, deploying, and running cloud-based services in a business environment.
- Illustrate the benefits and drive the adoption of cloud-based services to solve real-world problems

UNIT I Cloud Service Management Fundamentals 6

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models.

UNIT II Cloud Services Strategy 6

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

UNIT III Cloud Service Management 6

Cloud Service Reference Model, Cloud Service Lifecycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management.

UNIT IV Cloud Service Economics 6

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription-based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.

UNIT V Cloud Service Governance & Value 6

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the Value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

NUMBER OF PRACTICAL PERIODS: 30

SAMPLE LIST OF EXPERIMENTS

1. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud softwares like Openstack, Eucalyptus, OpenNebula with Role-based access control
2. Create a Cost-model for a web application using various services and do Cost-benefit analysis
3. Create alerts for usage of Cloud resources
4. Create Billing alerts for your Cloud Organization
5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one.

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

CO1: Exhibit cloud-design skills to build and automate business solutions using cloud technologies.
CO2: Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services.
CO3: Solve the real-world problems using Cloud services and technologies.

TEXTBOOKS:

1. Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3. Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

REFERENCES:

1. Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

Course Code	**DevOps**	L	T	P	C
BM4V75		2	0	2	3

COURSE OBJECTIVES:

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial

- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT I Introduction to DEVOPS **6**

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

UNIT II Compile and Build Using Maven & Gradle **6**

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases (compile build, test, package) Maven Profiles, Maven repositories (local, central, global), Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, understand build using Gradle

UNIT III Continuous Integration Using Jenkins **6**

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV Configuration Management Using Ansible **6**

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

UNIT V Building Devops Pipelines Using Azure **6**

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines' file

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

NUMBER OF PRACTICAL PERIODS : 30

SAMPLE LIST OF EXPERIMENTS

1. Create Maven Build pipeline in Azure
2. Run regression tests using Maven Build pipeline in Azure
3. Install Jenkins in Cloud
4. Create CI pipeline using Jenkins
5. Create a CD pipeline in Jenkins and deploy in Cloud
6. Create an Ansible playbook for a simple web application infrastructure
7. Build a simple application using Gradle
8. Install Ansible and configure ansible roles and to write playbooks

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Understand different actions performed through Version control tools like Git.
CO2: Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
CO3: Ability to Perform Automated Continuous Deployment
CO4: Ability to do configuration management using Ansible
CO5: Understand to leverage Cloud-based DevOps tools using Azure DevOps

TEXTBOOKS:

1. Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
2. Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014

REFERENCES:

1. Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni
2. Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.
3. David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.
4. Mariot Tsitoara, "Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.
5. https://www.jenkins.io/user-handbook.pdf
6. https://maven.apache.org/guides/getting-started/

Course Code	**Web Frameworks**	L	T	P	C
BM4V76		2	0	2	3

COURSE OBJECTIVES:

- To build scalable web applications using Angular
- To import and export functionalities of modules using Angular
- To create reusable UI components using React
- To manage state of the application more efficiently using React Hook
- To containerize the applications using Docker ad Kubernetes

UNIT I Angular V 12 **6**

Introduction to Angular – Typescript (Arrays, Functions, classes) – JS vs TS – Angular CLI Installation – Components – Data Binding – Routing on Angular - Directives

UNIT II Angular Modules and Material **6**

Angular Modules – HTTP client, Forms Module – Angular Service Files – Dependancy Injection – Angular Material – Connecting Angular with Back End

UNIT III React V 18 **6**

Introduction to React – Setting development environment – create app – JSX syntax – properties and states – components – React routing – API request

UNIT IV React Hooks **6**

React Hooks – useState – useEffect – useCallback – useMemo – useContext – useReducer – Introduction to React Native

UNIT V Containerization **6**

Introduction to Image and Container – Docker – Containers – Docker Images, Docker file, Docker Network – Docker Compose - Kubernetes

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

NUMBER OF PRACTICAL PERIODS: 30

SAMPLE LIST OF EXPERIMENTS

1. Project – Create an angular app with n components and add routing
2. Project – Add functionalities, validation and database with above components
3. Project – Create Login System using React
4. Project – Create Flight Management system

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Build scalable web applications using Angular
CO2: Import and export functionalities of modules using Angular
CO3: Create reusable UI components using React
CO4: Manage state of the application more efficiently using React Hook
CO5: Containerize the applications using Docker ad Kubernetes

TEXTBOOKS:

1. Nate Murray, Felipe Coury, Ari Lerner, Carlos Taborda, " The Ng book — The Complete Book on Angular"
2. The Road to React, Robin Wieruch,2023.
3. The Docker Book: Containerization is the new virtualization, James Turnbull, 2014.
4. The Kubernetes Book, Nigel Poulton, 2023.

REFERENCES AND ONELINE RESOURCES:

1. https://angular.io/docs
2. https://react.dev/
3. https://react.dev/reference/react
4. https://docs.docker.com/
5. https://kubernetes.io/docs/home/

Course Code	Middle Tire Technologies	L	T	P	C
BM4V77		2	0	2	3

COURSE OBJECTIVES:

- To study the set of services that a middleware system constitutes of.
- To understand how middleware facilitates the development of distributed applications in heterogeneous environments
- To study how it helps to incorporate application portability, distributed application component interoperability and integration.
- To learn the object oriented middleware basics through the example of the following CORBA objects.
- To understand the basics of Web services that is the most oft-used middleware technique

UNIT I Client/ Server Concepts **6**

Client – Server – File Server, Database server, Group server, Object server, Web server .Middleware – General middleware – Service specific middleware. Client / Server Building blocks – RPC – Messaging – Peer – to- Peer.

UNIT II EJB Architecture **6**

EJB – EJB Architecture – Overview of EJB software architecture – View of EJB – Conversation – Building and Deploying EJBs – Roles in EJB.

UNIT III EJB Applications **6**

EJB Session Beans – EJB entity beans – EJB clients – EJB Deployment – Building an application with EJB.

UNIT IV CORBA **6**

CORBA – Distributed Systems – Purpose – Exploring CORBA alternatives – Architecture overview – CORBA and networking model – CORBA object model – IDL – ORB – Building an application with CORBA.

UNIT V COM **6**

COM – Data types – Interfaces – Proxy and Stub – Marshalling – Implementing Server / Client – Interface Pointers – Object Creation, Invocation , Destruction – Comparison COM and CORBA – Introduction to .NET – Overview of .NET architecture – Marshalling – Remoting.

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

NUMBER OF PRACTICAL PERIODS: 30

SAMPLE LIST OF EXPERIMENTS

1. Dynamic Mechanical Analysis
2. Tribometer Testing
3. Rheometry
4. Accelerated Aging Tests
5. Recent advances in MTT Laboratory Experiments

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Understanding the basic concepts of web application security and the need for it
CO2: Be acquainted with the process for secure development and deployment of web applications
CO3: Acquire the skill to design and develop Secure Web Applications that use Secure APIs
CO4: Be able to get the importance of carrying out vulnerability assessment and penetration testing
CO5: Acquire the skill to think like a hacker and to use hackers tool sets

TEXTBOOKS:

1. Robert Orfali, Dan Harkey and Jeri Edwards, "The Essential Client/Server Survival Guide", Galgotia Publications Pvt. Ltd., 2002. (Unit 1)
2. Tom Valesky,"Enterprise Java Beans",Pearson Education, 2002.(Unit 2 & 3)
3. Jason Pritchard,"COM and CORBA side by side", Addison Wesley,2000 (Unit 4 & 5)
4. Jesse Liberty, "Programming C#", 2nd Edition, O'Reilly Press, 2002. (Unit 5)

REFERENCES:

1. Mowbray,"Inside CORBA", Pearson Education, 2002.
2. Jeremy Rosenberger," Teach yourself CORBA in 14 days", Tec media, 2000

Course Code	**Web Application Security**	L	T	P	C
BM4V78		2	0	2	3

COURSE OBJECTIVES:

- To understand the fundamentals of web application security
- To focus on wide aspects of secure development and deployment of web applications
- To learn how to build secure APIs
- To learn the basics of vulnerability assessment and penetration testing
- To get an insight about Hacking techniques and Tools

UNIT I Fundamentals of Web Application Security **6**

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT II Secure Development and Deployment **6**

Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT III Secure API Development **6**

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV Vulnerability Assessment and Penetration Testing **6**

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database-based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT V Hacking Techniques and Tools **6**

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

NUMBER OF PRACTICAL PERIODS: 30

SAMPLE LIST OF EXPERIMENTS

1. Install wireshark and explore the various protocols
   a. Analyze the difference between HTTP vs HTTPS
   b. Analyze the various security mechanisms embedded with different protocols.
2. Identify the vulnerabilities using OWASP ZAP tool
3. Create simple REST API using python for following operation
   a. GET
   b. PUSH
   c. POST
   d. DELETE
4. Install Burp Suite to do following vulnerabilities:
   a. SQL injection
   b. cross-site scripting (XSS)
5. Attack the website using Social Engineering method

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

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

CO1: Understanding the basic concepts of web application security and the need for it
CO2: Be acquainted with the process for secure development and deployment of web applications
CO3: Acquire the skill to design and develop Secure Web Applications that use Secure APIs
CO4: Be able to get the importance of carrying out vulnerability assessment and penetration testing
CO5: Acquire the skill to think like a hacker and to use hackers tool sets

TEXTBOOKS:

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

REFERENCES:

1. Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
2. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
3. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4. Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

APPENDIX B: OPEN ELECTIVES

Open Elective - I	Open Elective - II
English for Competitive Examinations	Project Report Writing
Basics for Innovative Product development	Advanced Numerical Methods
Sustainable Manufacturing	Random Processes
Principles of Management	Queuing and Reliability Modelling
Entrepreneurship for Engineers	Production and Operations Management for Entrepreneurs
Total Quality Management	Multivariate Data Analysis
Intellectual Property Rights	Additive Manufacturing
Professional Ethics	New Product Development
Human Resource Management	Industrial Design & Rapid Prototyping Techniques
Industrial Safety Engineering	Micro and Precision Engineering
Industrial Management	Cost Management of Engineering Projects
Quality Engineering	Batteries and Management system
Introduction to non- destructive testing	Sensors and Actuators
Mechatronics	Space Vehicles

Foundation of Robotics	Management Science
Functional Materials	Production Planning and Control
Traditional Indian Foods	Operations Management
Introduction to food processing	Industrial Hygiene
IPR for Pharma Industry	Java programming
Basics of Textile Finishing	Software Engineering
Embedded system design for Medical Devices	Database Management system
Nano Technology	R programming
Crypto currency & Block chain Technology	Data science fundamentals
Computer Networks	Advance Programming in C and Python
Drone Technologies	Cyber Security
Visual communication design	Cloud Computing
	Design culture and service

OPEN ELECTIVES –I

Course Code	**English for Competitive Examinations**	L	T	P	C
SH4609		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS)
- To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests
- To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.
- To improve students' confidence to express their ideas and opinions in formal contexts
- To create awareness of accuracy and precision in communication

UNIT I Vocabulary – Verbal Ability **9**

Orientation on different formats of competitive exams - Vocabulary – Verbal ability – Verbal reasoning - Exploring the world of words – Essential words – Meaning and their usage – Synonyms-antonyms – Word substitution – Word analogy – Idioms and phrases – Commonly confused words – Spellings – Word expansion – New words in use

UNIT II Grammer and Sentence Formation **9**

Grammar – Sentence improvement –Sentence completion – Rearranging phrases into sentences – Error identification –Tenses – Prepositions – Adjectives – Adverbs – Subject-verb agreement – Voice – Reported speech – Articles – Clauses – Speech patterns.

UNIT III Reading and Summarizing **9**

Reading - Specific information and detail – Identifying main and supporting ideas – Speed reading techniques – Improving global reading skills – Linking ideas – Summarizing – Understanding argument – Identifying opinion/attitude and making inferences - Critical reading.

UNIT IV Paragraph Writing **9**

Writing – Pre-writing techniques – Mindmap - Describing pictures and facts - Paragraph structure – organising points – Rhetoric writing – Improving an answer – Drafting, writing and developing an argument – Focus on cohesion – Using cohesive devices –Analytic writing – Structure and types of essay – Mind maps – Structure of drafts, letters, memos, emails – Statements of Purpose – Structure, Content and Style.

UNIT V Listening and Speaking **9**

Listening and Speaking – Contextual listening – Listening to instructions – Listening for specific information – Identifying detail, main ideas – Following signpost words – Stress, rhythm and intonation - Speaking to respond and elicit ideas – Guided speaking – Opening phrases – Interactive communication – Dysfluency -Sentence stress – Speaking on a topic – Giving opinions – Giving an oral presentation – Telling a story or a personal anecdote – Talking about oneself - Utterance – Speech acts- Brainstorming ideas – Group discussion

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required
CO2: Identify errors with precision and write with clarity and coherence
CO3: Understand the importance of task fulfilment and the usage of task-appropriate vocabulary
CO4: Communicate effectively in group discussions, presentations and interviews
CO5: Write topic-based essays with precision and accuracy

TEXT BOOKS:

1. R.P.Bhatnagar - General English for Competitive Examinations. Macmillan India Limited, 2009

REFERENCES:

1. Educational Testing Service - The Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.
2. The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010
3. R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008

Course Code	**Basics for Innovative Product development**	L	T	P	C
PR4601		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Introduce tools & techniques of design thinking for innovative product
- development Illustrate customer-centric product innovation using on simple
- use cases Demonstrate development of Minimum usable Prototypes
- Outline principles of solution concepts & their evaluation
- Describe system thinking principles as applied to complex systems

UNIT I Design Thinking Principles **9**

Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, building techniques, Mitigate validation risk with FIR [Forg Innovation rubric] - Case studies

UNIT II Enduser-Centric Innovation **9**

Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visit

UNIT III Applied Design Thinking Tools **9**

Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design.

UNIT IV Concept Generation **9**

Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts

UNIT V System Thinking **9**

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Test various hypotheses to mitigate the inherent risks in product innovations.
CO2: Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.
CO3: Develop skills in design thinking, critical thinking, analyzing and pitching
CO4: Exploration of solution for Conceptualization and protype building

CO5: Apply system thinking in a real-world scenario

TEXT BOOKS:

1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
2. Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value
3. Proposition Design: How to Create Products and Services Customers Want, Wiley
4. Donella H. Meadows, (2015), "Thinking in Systems -A Primer", Sustainability Institute.
5. Tim Brown,(2012) "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Harper Business

REFERENCES:

1. https://www.ideou.com/pages/design-thinking#process
2. https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations49f253ca86
3. https://blog.forgefor ward.in/product-innovation-rubric-adf5ebdfd356
4. https://blog.forgefor ward.in/evaluating-product-innovations-e8178e58b86e
5. https://blog.forgefor ward.in/user-guide-for-product-innovation-rubric-857181b253dd
6. https://blog.forgefor ward.in/star-tup-failure-is-like-true-lie-7812cdfe9b85

Course Code	**Sustainable Manufacturing**	L	T	P	C
PR46O2		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To be acquainted with sustainability in manufacturing and its evaluation.
- To provide knowledge in environment and social sustainability.
- To provide the student with the knowledge of strategy to achieve sustainability.
- To familiarize with trends in sustainable operations.
- To create awareness in current sustainable practices in manufacturing industry.

UNIT I Economic Sustainability **9**

Industrial Revolution-Economic sustainability: globalization and international issues Sustainability status - Emerging issues- Innovative products- Reconfiguration manufacturing enterprises -Competitive manufacturing strategies - Performance evaluation- Management for sustainability -Assessments of economic sustainability

UNIT II Social and Environmental Sustainability **9**

Social sustainability – Introduction-Work management -Human rights - Societal commitment - Customers -Business practices -Modelling and assessing social sustainability. Environmental

issues pertaining to the manufacturing sector: Pollution - Use of resources -Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability.

UNIT III Sustainability Practices **9**

Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements –Cost and time model.

UNIT IV Manufacturing Strategy for Sustainability **9**

Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options -Approaches to strategy formulation - Realization of new strategies/system designs.

UNIT V Trends in Sustainable Operations **9**

Principles of sustainable operations - Life cycle assessment manufacturing and service activities -influence of product design on operations - Process analysis – Capacity management – Quality management -Inventory management - Just-In-Time systems - Resource efficient design - Consumerism and sustainable well-being**.**

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Discuss the importance of economic sustainability.
CO2: Describe the importance of sustainable practices.
CO3: Identify drivers and barriers for the given conditions.
CO4: Formulate strategy in sustainable manufacturing.
CO5: Plan for sustainable operation of industry with environmental, cost consciousness

TEXT BOOKS:

1. Ibrahim Garbie, “Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0”, Springer International Publishing., United States, 2016, ISBN-13: 978-3319293042.
2. Davim J.P., “Sustainable Manufacturing”, John Wiley & Sons., United States, 2010,ISBN: 978-1-848-21212-1.

REFERENCES:

1. Jovane F, Ęmper, W.E. and Williams, D.J., "The ManuFuture Road: Towards Competitive and Sustainable High-Adding-Value Manufacturing", Springer,2009, United States, ISBN 978-3-540-77011-4.
2. Kutz M., "Environmentally Conscious Mechanical Design", John Wiley & Sons., United States, 2007, ISBN: 978-0-471-72636-4.
3. Seliger G., "Sustainable Manufacturing: Shaping Global Value Creation", Springer, United States, 2012, ISBN 978-3-642-27289-9.

Course Code	**Principles Of Management**	L	T	P	C
PR46O3		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business

UNIT I Introduction to Management and Organizations **9**

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management

UNIT II Planning **9**

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III Organising **9**

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV Directing **9**

Foundations of individual and group behavior– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership –

Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V Controlling **9**

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting

45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.
CO2: Have same basic knowledge on international aspect of management.
CO3: Being able to grasp organizational concepts in the realm of management.
CO4: To apply the managerial idea of directing.
CO5: Comprehend the management idea of controlling.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
2. Stephen P. Robbins and Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES:

1. Robert Kreitner and MamataMohapatra, " Management", Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.

Course Code	**Entrepreneurship for Engineers**	L	T	P	C
MG46O1		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To learn fundamentals of entrepreneurship
- To apply the methods of entrepreneurship
- To evaluate the medical devices and market trends

UNIT I Introduction to Entrepreneurship **9**

Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development

UNIT II Business Ownership & Environment **9**

Types of Business Ownership – Business Environmental Factors – Political-Economic Sociological-Technological-Environmental-Legal aspects – Human Resources Mobilisation-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration.

UNIT III New Venture **9**

Developing an Effective Business Model: The Importance of a Business Model – Starting a small scale industry - Components of an Effective Business Model. Assessing the venture, establish venture invention, market research, presenting the business plan. Forms of Business Organization: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. case study

UNIT IV Financing the New Venture and Globalization **9**

Evaluating Various options and future investments – Medical Device entrepreneurship incentives and subsidies – Determining Financial Needs – Sources of Financing: support for product development, funding agencies, collaborative initiatives, and angel investors. Impact of Globalization: Medical product manufacturing, marketing, leadership, quality management. Case studies

UNIT V Marketing Function **9**

Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. Case study

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Learn the basics of Entrepreneurship
CO2: Understand the business ownership patterns and environment.
CO3: Acquire the skills and techniques required towards innovation
CO4: Categorize the resources and funding agencies and judge the right product based on market needs
CO5: Compile and quantify the opportunities and challenges

TEXT BOOKS:

1. Jen-Shih Lee “Biomedical Engineering Entrepreneurship”, World Scientific Publishing, USA. 2010
2. Vasant Desai, —The Dynamics of Entrepreneurial Development and Management||, Himalaya Publishing House, 2010.

REFERENCES:

1. Brant Cooper, Patrick Vlaskovits, "The Lean Entrepreneur", Wiley, 2nd edition, New Jersy, 2016.
2. Nathan Furr, Jeff Dyer, "The Innovator's Method: Bringing the Lean Start-up into Your Organzation", Harvard Business Press, Boston, 2014.
3. Donald F.Kuratko and Richard M. Hodgetts, "Entrepreneurship", South-Western.
4. Gupta S.L., Arun Mittal, "Entrepreneurship Development", International Book House, 2012.
5. Prasanna Chandra, "Projects- Planning, Analysis, Financing, Implementation and review||, TATA McGraw Hill, 2012.

Course Code	**Total Quality Management**	L	T	P	C
MG4602		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM
- Explain the TQM Principles for application
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Illustrate and apply QMS and EMS in any organization

UNIT I Introduction **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM Principles **9**

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development

UNIT III TQM Tools & Techniques I **9**

The seven traditional tools of quality - New management tools - Six-sigma Process Capability Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent, Documentation, Stages: Design FMEA and Process FMEA

UNIT IV TQM Tools & Techniques II **9**

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR

UNIT V Quality Management System **9**

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand TQM concepts in a selected enterprise
CO2: Understand the TQM principles in a selected enterprise.
CO3: Apply Six Sigma, Traditional tools, New tools, Benchmarking and FMEA
CO4: Formulate Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
CO5: Apply QMS and EMS in any organization

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna, Glen H. Bester field, MaryB.Sacre, HemantUrdhwareshe and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCE:

1. Joel.E. Ross, “Total Quality Management – Text and Cases”,Routledge.,2017.
2. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition,2003.
4. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006

Course Code	Intellectual Property Rights	L	T	P	C
PR46O4		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Teach the need for IPR, its evolution, basic concepts, contribution of quality gurus,
- To give an idea about IPR, registration and its enforcement.

UNIT I Introduction **9**

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II Registration of IPRs **9**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III Agreements and Legislations **9**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV Digital Products and Law **9**

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V Enforcement of IPRs **9**

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the various IPR techniques.
CO2: Design the practical aspects registration procedure.
CO3: Develop different tools for framing Agreement
CO4: Exploration of digital products and law
CO5: Apply enforcement of IPRs

TEXT BOOKS:

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, “Intellectual Property Rights and Copy Rights, Ess Ess Publications, NewDelhi, 2002 95Reprint, Sixth Impression, 2013.

REFERENCES:

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

Course Code	**Professional Ethics**	L	T	P	C
MG46O2		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To understand Human Values.
- To learn Ethics to be followed during Engineering profession.
- To instill moral and social values.
- To appreciate the right to others.

UNIT I Human Values **9**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self Confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II Engineering Ethics **9**

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III Engineering and Social Experimentation **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV Safety, Responsibility and Rights **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V Global Issues **9**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the Ethics in society.
CO2: Discuss the ethical issues related to Engineering.
CO3: Realize the responsibilities and Rights in the Society
CO4: Apply and asses the safety and risk measures
CO5: Discuss the ethical issues related Global issues

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw Hill, New Delhi,2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, Engineering Ethics, Prentice Hall of India, New Delhi, 2004.Reprint, Sixth Impression,2013.

REFERENCES:

1. Charles B. Fleddermann, —Engineering Ethics, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, —Engineering Ethics – Concepts and Cases, Cengage Learning, 2009.
3. John R Boatright, —Ethics and the Conduct of Business, Pearson Education, New Delhi, 2003

Course Code	**Human Resource Management**	L	T	P	C
MG4603		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To share knowledge regarding staffing-related management difficulties.
- Provide insights into training-related management challenges.
- To share knowledge on performance-related management concerns.
- To provide information on compensation and management concerns.
- Provide insights into human factors issues and human resource compliance in management.

UNIT I Introduction to Human Resource Management **9**

The importance of human resources – Objective of Human Resource Management – Human resource policies - Role of human resource manager.

UNIT II Human Resource Planning **9**

Compensation plan – Reward – Motivation – Career Development - Mentor – Protégé Relationships.

UNIT III Training and Executive Development **9**

Types of training and Executive development methods – purpose – benefits.

UNIT IV Employee Compensation **9**

Compensation plan – Reward – Motivation – Career Development - Mentor – Protégé relationships.

UNIT V Performance Evaluation and Control **9**

Performance evaluation – Feedback - The control process – Importance – Methods – grievances – Causes – Redressal methods.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the knowledge on the various aspects of HRM
CO2: Plan the knowledge needed for success as a human resources professional.
CO3: Develop the skills needed for a successful HR manager.
CO4: To implement the concepts learned in the workplace.
CO5: Apply the emerging concepts in the field of HRM

TEXT BOOKS:

1. Decenzo and Robbins, Human Resource Management, 8th Edition, Wiley, 2007.
2. John Bernardin. H., Human Resource Management – An Experimental Approach;, 5th Edition, Tata McGraw Hill, 2013, New Delhi.

REFERENCES:

1. Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, "Managing Human Resources;,7th Edition, PHI, 2012.
2. Dessler, ;Human Resource Management;, Pearson Education Limited, 2007.

Course Code	**Industrial Safety Engineering**	L	T	P	C
PR4605		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To understand the basic safety terminologies

- To learn about the important Statutory Regulations and standards.
- To conduct and participate the various safety activities in the industry.
- To have knowledge about workplace exposures and Hazards.
- To access various hazards and consequences through various Risk Assessment Techniques

UNIT I Safety Terminologies **9**

The importance of human resources – Objective of Human Resource Management – Human resource policies - Role of human resource manager.

UNIT II Standards and Regulations **9**

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) – Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006.

UNIT III Safety Activities **9**

Toolbox Talk-Role of Safety Committee – Responsibilities of safety officers and Safety Representatives- Safety Training and Safety Incentives – Mock Drils – On-site Emergency Action Plan – Off-site Emergency Action Plan – Safety poster and display – Human Error Assessment

UNIT IV Workplace Health and Safety **9**

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V Hazard Identification Techniques **9**

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event T ree Analysis Qualitative and Quantitative Risk Assessment Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the basic concept of safety.
CO2: Obtain knowledge of Statutory Regulations and standards.
CO3: Know about the safety Activities of the Working Place.
CO4: Analyze on the impact of Occupational Exposures and their Remedies
CO5: Obtain knowledge of Risk Assessment Techniques.

TEXT BOOKS:

1. R.K.Jain and Prof.Sunil S.Rao, Industrial Safety, Health and Environment Management Systems, Khanna Publisher.
2. L.M.Deshmukh, Industrial Safety Management: Hazard Identification and Risk Control, McGraw-Hill Education

REFERENCES:

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring.(1996).Safety management system: Chapman & Hall, England
5. Society of Safety Engineers, USA

Course Code	**Industrial Management**	L	T	P	C
MG4604		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
- To study the planning; organizing and staffing functions of management in professional organization.
- To study the leading; controlling and decision making functions of management in professional organization.
- To learn the organizational theory in professional organization.
- To learn the principles of productivity and modern concepts in management in professional organization.

UNIT I Introduction to Management **9**

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT II Functions of Management – I **9**

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT III Functions of Management – II **9**

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications

UNIT IV Organization Theory **9**

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT V Productivity and Modern Topics **9**

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS)

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
CO2: Discuss the planning; organizing and staffing functions of management in professional organization.
CO3: Apply the leading; controlling and decision-making functions of management in professional organization.
CO4: Discuss the organizational theory in professional organization.
CO5: Apply principles of productivity and modern concepts in management in professional organization.

TEXT BOOKS:

1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009.
2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCES:

1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.
2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.
3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.
4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012.
5. S. TrevisCerto, "Modern Management Concepts and Skills", Pearson Education, 2018.

Course Code	**Quality Engineering**	L	T	P	C
PR46O6		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To develop a clear knowledge in the basics of various quality concepts.
- To understand the application of control charts and its techniques.
- To develop special control procedures for service and process oriented industries.
- To Analyze and understand the process capability study.
- To Develop the acceptance sampling procedures for incoming raw material.

UNIT I Introduction **9**

Quality Dimensions–Quality definitions–Inspection-Quality control–Quality Assurance–Quality planning-Quality costs–Economics of quality– Quality loss function.

UNIT II Control Charts **9**

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- *X*, R and S charts, attribute control charts - p, np, c and u- Construction and application.

UNIT III Special Control Procedures **9**

Warning and modified control limits, control chart for individual measurements, multi-vari chart, *X*chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV Statistical Process Control **9**

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits

UNIT V Acceptance Sampling **9**

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables,MIL-STD-105DandMIL-STD-414E&IS2500 standards.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Control the quality of processes using control charts for variables in manufacturing industries.
CO2: Control the occurrence of defective product and the defects in manufacturing companies.
CO3: Control the occurrence of defects in services.
CO4: Analyze and understanding the process capability study.
CO5: Develop the acceptance sampling procedures for incoming raw material.

TEXT BOOKS:

1. Douglas C Montgomery, Introduction to Statistical Quality Control, John Wiley, Seventh Edition, 2012.

REFERENCE:

1. Grant E.L. and Leavens worth, Statistical Quality Control, TMH, 2000.
2. IS 2500 Standard sampling plans.
3. K Krishnaiah, Applied Statistical Quality control and Improvement, PHI, 2014.

Course Code	**Introduction to Non Destructive Testing**	L	T	P	C
PR46O7		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To understand the basic importance of NDT in quality assurance.
- To Imbibe the basic principles of various NDT techniques, its applications, limitations, codes and standards.
- To Equip themselves to locate a flaw in various materials, products.
- To Apply the testing methods for inspecting materials in accordance with industry specifications and standards.
- To Acquire the knowledge on the selection of the suitable NDT technique for a given application

UNIT I Introduction to NDT & Visual Testing **9**

Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental

factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting

UNIT II Liquid Penetrant & Magnetic Particle Testing **9**

Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation. Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications.

UNIT III Eddy Current Testing & Thermography **9**

Eddy Current Testing: Generation of eddy currents– properties– eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation. Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.

UNIT IV Ultrasonic Testing & AET **9**

Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration. Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications.

UNIT V Radiography Testing **9**

Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and creens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, enetrameters, safety in radiography.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Realize the importance of NDT in various engineering fields.
CO2: Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.

CO3: Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.
CO4: Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.
CO5: Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.

TEXT BOOKS:

1. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002.
2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition, 2011.
3. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.

REFERENCE:

1. ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001.
2. Barry Hull and Vernon John, "Nondestructive Testing", Macmillan, 1989.
3. Chuck Hellier, "Handbook of Nondestructive Evaluation", Mc Graw Hill, 2012.
4. Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995

Course Code	**Mechatronics**	L	T	P	C
MT4609		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To Select sensors to develop mechatronics systems.
- To Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
- To Design appropriate interfacing circuits to connect I/O devices with microprocessor.
- To Apply PLC as a controller in mechatronics system.
- To Design and develop the apt mechatronics system for an application.

UNIT I Introduction and Sensors **9**

Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors.

UNIT II 8085 Microprocessor **9**

Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.

UNIT III Programmable Peripheral Interface **9**

Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.

UNIT IV Programmable Logic Controller **9**

Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC

UNIT V Actuators and Mechatronics System Design **9**

Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Select sensors to develop mechatronics systems.
CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.
CO4: Apply PLC as a controller in mechatronics system.
CO5: Design and develop the apt mechatronics system for an application.

TEXT BOOKS:

1. Bolton W., “Mechatronics”, Pearson Education, 6th Edition, 2015.
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, Penram International Publishing Private Limited, 6th Edition, 2013.

REFERENCE:

1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., “Mechatronics”, Chapman and Hall, 1993.
2. Davis G. Alciatore and Michael B. Histand, “Introduction to Mechatronics and Measurement systems”, McGraw Hill Education, 2011.
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, Cengage Learning, 2010.
4. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and Applications”, McGraw Hill Education, 2015.
5. Smaili. A and Mrad. F, “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007

Course Code	**Foundation of Robotics**	L	T	P	C
MT4608		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To study the kinematics, drive systems and programming of robots.
- To study the basics of robot laws and transmission systems.
- To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
- To familiarize students with the various Programming and Machine Vision application in robots.
- To build confidence among students to evaluate, choose and incorporate robots in engineering systems

UNIT I Fundamentals of Robot **9**

Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors.

UNIT II Robot Kinematics **9**

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

UNIT III Robot Drive Systems and End Effectors **9**

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper.

UNIT IV Sensors in Robotics **9**

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation

UNIT V Programming and Applications of Robot **9**

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Interpret the features of robots and technology involved in the control.
CO2: Apply the basic engineering knowledge and laws for the design of robotics.
CO3: Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.
CO4: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.
CO5: Demonstrate the image processing and image analysis techniques by machine vision system.

TEXT BOOKS:

Ganesh.S.Hedge,"A textbook of Industrial Robotics", Lakshmi Publications, 2006.

REFERENCES:

1. Fu K.S. Gonalz R.C. and ice C.S.G."Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book co. 2007.
2. YoramKoren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.
3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005.
4. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002.
5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.

Course Code	**Functional Materials**	L	T	P	C
SH4608		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To understand functional material.
- To organize the molecular self-assembly
- To create different bioinspired material
- To develop intelligent materials
- To develop electronic polymers

UNIT I Introduction **9**

Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modeling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact.

UNIT II Molecular Self Assembly **9**

Molecular Organization, Self-Assembly in Biology, Energetics of Self-Organization, A Few Case Studies, Synthetic Protocols and Challenges, Solvent-assisted Self-Assembly, Directed Assembly Langmuir-Blodgett and Langmuir-Schaefer techniques, Technological Applications of SAMs.

UNIT III Bio-Inspired Materials **9**

Bio-inspired materials, Classification, Biomimicry, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid, 'Bionics'-Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization En route to Nanotechnology.

UNIT IV Smart or Intelligent Materials **9**

Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electroceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composities

UNIT V Materials for Polymer Electronics **9**

Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Differentiate among various functional properties
CO2: Select appropriate material for certain functional applications
CO3: Analyze the bio inspired materials.
CO4: Create smart intelligent material
CO5: Design the electronics polymer material

TEXT BOOKS:

1. Vijayamohanan K. Pillai and Meera Parthasarathy, "Functional Materials: A chemist's perpective", Universities Press Hyderabad (2012)

REFERENCES:

1. Stephen Manne "Biomimetic Materials Chemistry" Wiley-VCH Newyork, 1966.

Course Code	**Traditional Indian Foods**	L	T	P	C
SH4607		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To help students acquire a sound knowledge on diversities of foods,
- To understand different food habits
- To relate different patterns in India with focus on traditional foods.

UNIT I Historical and Cultural Perspectives **9**

Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts.

UNIT II Traditional Methods of Food Processing **9**

Traditional methods of milling grains – rice, wheat and corn – equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation – sundrying, osmotic drying, brining, pickling and smoking.

UNIT III Traditional Food Patterns **9**

Typical breakfast, meal and snack foods of different regions of India. Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods,pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods

UNIT IV Commercial Production of Traditional Foods **9**

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.

UNIT V Health Aspects of Traditional Foods **9**

Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the historical perspective of foods and food habits
CO2: Analyse the wide diversity of traditional Indian foods and meal patterns.
CO3: Interpret the traditional perspective of foods and food habits
CO4: Analyse the common features of traditional Indian foods and meal patterns.
CO5: Analyse the health aspects of traditional foods.

TEXT BOOKS:

1. Sen, Colleen Taylor "Food Culture in India" Greenwood Press, 2005

REFERENCES:

1. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001.

Course Code	**Introduction to Food Processing**	L	T	P	C
BT4601		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- The course aims to introduce the students to the area of Food Processing.
- To understanding of a detailed study of food processing and technology subjects.
- To appreciate the importance of food processing with respect to the producer, manufacturer and consumer

UNIT I Processing of Food and Its Importance **9**

Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods

UNIT II Methods of Food Handling and Storage **9**

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

UNIT III Large-Scale Food Processing **9**

Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods

UNIT IV Food Wastes in Various Processes **9**

Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment

UNIT V Food Hygiene **9**

Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Familiarize yourself with various techniques utilized in food processing.
CO2: Gain an understanding of food handling and storage methods.
CO3: Recognize the importance of food processing and the role played by food and beverage industries in the food supply chain.
CO4: Analyse the food wastage in different processes.
CO5: Analyse the food hygiene practices.

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M "Food Preservation and Safety Principles and Practice".Surbhi Publications, 2001.

REFERENCES:

1. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.
2. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005

Course Code	**IPR for Pharma Industry**	L	T	P	C
BT4602		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level
- To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications
- To study significance of the amended patent act on pharma industry.

UNIT I Introduction- Intellectual Property Rights **9**

Introduction, Types of Intellectual Property Rights -patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT II Patents **9**

Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Nonobviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.

UNIT III Plant Variety-Traditional Knowledge –Geographical Indications **9**

Plant variety- Justification, criteria for protection of plant variety and protection in India. Traditional knowledge- Concept of traditional knowledge, protection of traditional knowledge under Intellectual Property frame works in national level and Traditional knowledge digital library (TKDL). Geographical Indications – Justification for protection, National and International position

UNIT IV Enforcement and Practical Aspects of IPR **9**

Introduction – civil remedies – injunction, damage, account of profit – criminal remedies – patent, trademark. Practical aspects – Introduction, benefits of licensing, licensing of basic types of IPR, licensing clauses of IPR. Case studies of patent infringement, compulsory licensing, simple patent license agreements

UNIT V International Background of Intellectual Property **9**

International Background of Intellectual Property- Paris Convention, Berne convention, World Trade Organization (WTO), World Intellectual Property Organization (WIPO), Trade Related Aspects of Intellectual Property Rights (TRIPS) and Patent Co-operation Treaty (PCT)

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand and differentiate the categories of intellectual property rights.
CO2: Describe about patents and procedure for obtaining patents.
CO3: Distinguish plant variety, traditional knowledge and geographical indications under IPR.

CO4: Provide the information about the different enforcements and practical aspects involved in protection of IPR.
CO5: Provide different organizations role and responsibilities in the protection of IPR in the 256 international level.

TEXT BOOKS:

1. N. Nagpal, M. Arora, M.R.D. Usman, S. Rahar, "Intellectual Property Rights" Edu creation Publishing, New Delhi, 2017.
2. The Patents Act, 1970 (Bare Act with Short Notes) (New Delhi: Universal Law Publishing Company Pvt. Ltd.2012
3. B.S. Rao, P.V. Appaji, "Intellectual Property Rights in Pharmaceutical Industry: Theory and Practice", 2015.

REFERENCES:

1. Patents for Chemicals, Pharmaceuticals, & Biotechnology-Fundamentals of Global Law, Practice and Strategy. Philip W. Grubb, Oxford University Press, 2004.
2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005
3. S. Lakshmana Prabu, TNK. Suriyaprakash, "Intellectual Property Rights", 1st ed., In Tech open access, Croatia, 2017.

Course Code	**Basics of Textile Finishing**	L	T	P	C
PR2608		3	0	0	3

COURSE OBJECTIVES:

The students should be made**:**

- To enable the students to understand the basics and different types of finishes required for textile materials and machines used for finishing.

UNIT I Resin Finishing **9**

Importance of finishing and its classification. Resin finishing: Mechanism of creasing, Types of Resins. Anti crease, wash and wear, durable press resin finishing. Study about eco friendly method of anti crease finishing.

UNIT II Flame Proof & Waterproof **9**

Concept of Flame proof & flame retardancy. Flame retardant finishes for cotton, Concept of waterproof and water repellent Finishes, Durable & Semi durable and Temporary finishes, Concept of Antimicrobial finish

UNIT III Soil Release and Antistatic Finishes **9**

Soil Release Finishing: Mechanism of soil retention & soil release. Anti pilling Finishing: chemical and mechanical methods to produce anti pilling. Concept of UV Protection finishes- Concept of antistatic finishes

UNIT IV Mechanical Finishes **9**

Mechanical finishing of textile materials - calendaring, compacting, Sanforising, Peach finishing. Object of Heat setting. Various methods of heat setting and mechanism of heat setting.

UNIT V Stiffening and Softening **9**

Concept of stiffening and softening of textile materials. Mechanism in the weight reduction of PET. Concept of Micro encapsulation techniques in finishing process, Nano finish, Plasma Treatment and Bio finishing.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the basics of Resin Finishing Process.
CO2: Understand the Concept of Flame proof & flame retardancy, waterproof and water repellent, Antimicrobial finishes.
CO3: Understand the Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.
CO4: Understand the Concept of Mechanical finishing.
CO5: Understand the basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.

TEXT BOOKS:

1. V.A.Shennai, "Technology of Finishing", Vol X, Sevak Publications, Mumbai.
2. Perkins, W.S., “Textile colouration and finishing”, Carolina Academic Press., U.K, ISBN: 0890898855.2004.

REFERENCES:

1. Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62.
2. Chakraborty, J.N, Fundamentals and Practices in colouration of Textiles, Woodhead Publishing India, 2009, ISBN-13:978-81-908001-4-3
3. W. D. Schindler and P. J. Hauser "Chemical finishing of textiles", Woodhead Publishing Cambridge England,2004

Course Code	**Embedded System Design for Medical Devices**	L	T	P	C
AC26O3		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Acquire knowledge and understand fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.
- Understand the hardware architecture and features of embedded microcontrollers and peripherals.

- Understand programming aspects of embedded system design.
- Understand IoT architecture and Build simple IoT Systems using embedded target boards.
- Understand IoMT infrastructure for healthcare applications

UNIT I Introduction to Embedded System Design **9**

Introduction to embedded processors- Application Areas- Categories of embedded processors Challenges in Embedded System Design, Design Process- Requirements- Specifications Hardware architecture- Software architecture-Introduction to Harvard & Von Neuman architectures CISC & RISC Architectures. CPU Bus- Bus Protocols- Bus Organisation, Memory Devices, and their Characteristics- RAM, EEPROM-Flash Memory- DRAM. BIOS, POST, Device Drivers

Laboratory experiments

1. Explore AVR/ARM based controllers using Embedded C.
2. Write Basic and arithmetic Programs Using Embedded C

UNIT II Peripheral Interfacing **9**

I/O Devices-Timers and Counters- Watchdog Timers, Interrupt Controllers- A/D and D/A, Interfacing- Memory interfacing with a case study- I/O Device Interfacing with case Study Programmed IO-Memory Mapped IO, Interfacing Protocols-SPI, I2C, USB, CAN, Ethernet/WiFi, Bluetooth

Laboratory experiments:

1. Write Embedded C program to test interrupt and timers.
2. Develop Real time applications – clock generation, waveform generation, counter using embedded C

UNIT III Embedded System Software Design **9**

Application Software, System Software, Design techniques – State diagrams, sequence diagrams flowcharts, etc., Model-based system engineering (MBSE), Use of High-Level Languages embedded C / C++ Programming, Integrated Development Environment tools- Editor- Compiler Linker- Automatic Code Generators- Debugger- Board Support Library- Chip Support Library, Analysis and Optimization-Execution Time- Energy & Power

Laboratory experiments

Develop simple application to interface DHT11 sensor with and write a program to display temperature humidity readings in LCD.

UNIT IV Design and Development of IOT **9**

Definition and characteristics of IoT, Technical Building blocks of IoT, Communication Technologies, Physical design of IoT - system building blocks - sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino), Benefits and impact of IoMT. Cybersecurity – vulnerability, penetration & encryption technologies

Laboratory experiments

1. Explore different communication methods with IoT devices.
2. To interface LED/Buzzer with platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on / off LED/Buzzer with specified delay.

3. To interface DC/stepper motor using relay with open platform/ Aurdino /Raspberry Pi. And write an embedded C program to turn on motor if push button is pressed.
4. Develop simple application – testing infrared sensor – IoT Applications – using open platform/Raspberry Pi.

UNIT V Internet of Medical Things **9**

Case studies – Novel Symmetrical Uncertainty Measure (NSUM) Technique for Diabetes Patients, Healthcare Monitoring system through Cyber-physical system, An loT Model for Neuro sensors, AdaBoost with feature selection using loT for somatic mutations evaluation in Cancer, A FuzzyBased expert System to diagnose Alzheimer's Disease, Secured architecture for loT enabled Personalized Healthcare Systems, Healthcare Application Development in Mobile and Cloud Environments.

Laboratory experiments

1. Develop IoMT Application using open platform/ Aurdino. /Raspberry Pi. and sensors such as temperature, ECG, Pulse etc.
2. Deploy IoMT applications using platforms.
3. Mini Project

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Explain fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.
CO2: Describe the hardware architecture and features of embedded microcontrollers and peripherals.
CO3: Explain software design tools and embedded system design programming phases.
CO4: Describe IoT Architectures and Build simple IoT Systems using embedded target boards.
CO5: Exhibit understanding of IoMT infrastructure for healthcare applications.

TEXT BOOKS:

1. Embedded Systems – A Contemporary Design Tool, James K Peckol, John Weily, 2008, ISBN: 0- 444-51616-6.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "loT Fundamentals: Networking Technologies, Protocols and Use Cases for lnternet of Things, Cisco Press, 2017.
3. Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, "lnternet of Things and Personalized Healthcare Systems", Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019

REFERENCES:

1. Introduction to Embedded Systems, Shibu K V, Tata McGraw Hill Education Private Limited, 2009, ISBN: 10: 0070678790 3.
2. Embedded Software Primer, David E.Simon, Addison Wesley, ISBN-13: 978-0201615692

3. The Intel Microprocessors, Architecture, Programming and Interfacing" Barry B.Brey, 6th Edition, Pearson Education.
4. Arshdeep Bahga, Vijay Madisetti, "lnternet of Things – A hands-on approach", Universities Press, 2015.

Course Code	Nano Technology	L	T	P	C
BT4604		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To provide a broad view of the nascent field of nanoscience and nanotechnology to undergraduates
- To explore the basics of nanomaterial synthesis and characterization.
- To introduce the applications of nanotechnology

UNIT I Introduction to Nanotechnology **9**

Basic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero dimensional, size and shape of nanoparticles; one-dimensional and two dimensional nanostructures- clusters of metals and semiconductors, bionano-particles.

UNIT II Fabrication and Characterization of Nanomaterials **9**

Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Gas, liquid, and solid –phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.

UNIT III Properties and Measurement of Nanomaterials **9**

Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

UNIT IV Nano Structures **9**

Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots. Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magnetoresistance, etc. Cells response to Nanostructures.

UNIT V Applications of Nanotechnology **9**

Nano electronics, Nanosensors, Nanotechnology in Diagnostics applications, Environmental and Agricultural Applications of nanotechnology, Nano technology for energy systems.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Describe the basic science behind the properties of materials.
CO2: Interpret the creation, characterization, and manipulation of nanoscale materials.
CO3: Comprehend the exciting applications of nanotechnology at the leading edge of scientific research.
CO4: Understand the different characterization techniques for nanomaterials
CO5: Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.

TEXT BOOKS:

1. Springer Handbook of Nanotechnology by Bharat Bhushan 2004.(Unit I – V)
2. Encyclopedia of Nanotechnology - Hari Singh Nalwa 2004. (Unit I – V)
3. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications" Imperial College Press, 2004
4. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis group 2012.

REFERENCES:

1. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009
2. Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
3. Handbook of Nanoceramics and their Based Nanodevices (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.

Course Code	**Crypto Currency & Block Chain Technology**	L	T	P	C
CY46O9		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To understand the basics of Blockchain
- To learn Different protocols and consensus algorithms in Blockchain
- To learn the Blockchain implementation frameworks
- To understand the Blockchain Applications
- To experiment the Hyperledger Fabric, Ethereum networks

UNIT I Introduction to Blockchain **9**

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic –Hash Function, Properties of a hash function-Hash pointer and Merkle tree

UNIT II Bitcoin and Cryptocurrency **9**

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.

UNIT III Bitcoin Consensus **9**

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW, Bitcoin PoW, Attacks on PoW, monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases

UNIT IV Hyperledger Fabric & Ethereum **9**

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V Blockchain Applications **9**

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, etc - Case Study.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand emerging abstract models for Blockchain Technology
CO2: Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
CO3: Conceptual understanding of the function of Blockchain as a method of securing distributed ledgers
CO4. Apply in the hyperledger Fabric and Ethereum platform
CO5: Apply to implement the Block chain Application.

TEXT BOOKS:

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.

REFERENCES:

1. Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3. Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015

4. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing
5. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

Course Code	**Computer Networks**	L	T	P	C
CY4608		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of TCP/IP protocol suite.
- To visualize the end-to-end flow of information.
- To learn the functions of network layer and the various routing protocols
- To familiarize the functions and protocols of the Transport layer

UNIT I Introduction and Application Layer **9**

Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Introduction to Sockets - Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP

UNIT II Transport Layer **9**

Introduction - Transport-Layer Protocols: UDP – TCP: Connection Management – Flow control - Congestion Control - Congestion avoidance (DECbit, RED) – SCTP – Quality of Service.

UNIT III Network Layer **9**

Switching : Packet Switching - Internet protocol - IPV4 – IP Addressing – Subnetting - IPV6, ARP, RARP, ICMP, DHCP

UNIT IV Routing **9**

Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing – OSPF – Path-vector routing - BGP - Multicast Routing: DVMRP – PIM

UNIT V Data Link and Physical Layers **9**

Data Link Layer – Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC – PPP - Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) - Physical Layer: Data and Signals - Performance – Transmission media- Switching – Circuit Switching.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Explain the basic layers and its functions in computer networks
CO2: Understand the basics of how data flows from one node to another in the crypto currency domain.
CO3: Analyze routing algorithms
CO4: Describe protocols for various functions in the network
CO5: Analyze the working of various application layer protocols.

TEXT BOOKS:

1. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.
2. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.

Course Code	**Drone Technologies**	L	T	P	C
MT4607		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To understand the basics of drone concepts
- To learn and understand the fundaments of design, fabrication and programming of drone
- To impart the knowledge of an flying and operation of drone
- To know about the various applications of drone
- To understand the safety risks and guidelines of fly safely

UNIT I Introduction to Drone Technology **9**

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.

UNIT II Drone Design, Fabrication and Programming **9**

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts - Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program -

Install program on computer Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III Drone Flying and Operation **9**

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications.

UNIT IV Drone Commercial Applications **9**

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.

UNIT V Future Drones and Safety **9**

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization-Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO5: Create the programs for various drones.

TEXT BOOKS:

1) Garvit Pandya, Basics of Unmanned Aerial Vehicles: Time to start working on Drone Technology, Notion Press (6 March 2021)

REFERENCES:

1) PK Garg, Introduction To Unmanned Aerial Vehicles, New Age International Publishers New Age International Private Limited; First edition (1 October 2020); NEW AGE International Pvt Ltd 2) Kike Calvo, So You Want to Create Maps Using Drones?

Course Code	Visual Communication Design	L	T	P	C
AC4604		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Apply appropriate communication skills across settings, purposes, and audiences.
- Demonstrate knowledge of communication theory and application.

UNIT I Fundamental of Visual Communication **9**

Need for and the Importance of Human and Visual Communication. Communication a expression, skill and process, Understanding Communication: SMRC-Model

UNIT II Levels of Communication **9**

Communication as a process. Message, Meaning, Connotation, Denotation Culture Codes etc Levels of communication: Technical, Semantic, and Pragmatic. The semiotic landscape: language and visual communication, narrative representation.

UNIT III Design of Communication Aspects **9**

Fundamentals of Design. Definition. Approaches to Design, Centrality of Design, Elements of Design Line, Shape, Space, Colour, Texture. Form Etc. Principles of Design: Symmetry, Rhythm Contrast, Balance Mass Scale etc. Design and Designers (Need, role, process, methodologies etc.)

UNIT IV Visual and Sensory Perception **9**

Principles of Visual and other Sensory Perceptions. Colour psychology and theory (some aspects) Definition, Optical/Visual Illusions Etc Various stages of design process- problem identification, search for solution refinement, analysis, decision making, and implementation.

UNIT V Graphic Design **9**

Basics of Graphic Design. Definition, Elements of GD, Design process-research, a source of concept, the process of developing ideas-verbal, visual, combination & thematic, visual thinking, associative techniques, materials, tools (precision instruments etc.) design execution, and presentation.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Demonstrate critical and innovative thinking.
CO2: Display competence in oral, written, and visual communication.
CO3: Apply communication theories.
CO4: Apply visual and sensory perception
CO5: Create a graphic design

TEXT BOOKS:

1. Lupton, E. (2010). Thinking with Type: A Critical Guide for Designers, Writers, Editors, & Students (2nd revised and expanded edition). Princeton Architectural Press.
2. Baldwin, J., & Roberts, L. (2006). Visual Communication: From Theory to Practice. AVA Publishing.

REFERENCES:

1. Communication between cultures - Larry A. Samovar, Richard E. Porter, Edwin R. McDaniel Carolyn Sexton Roy, Monica Eckman, USA, 2012
2. Introduction to Communication studies - John Fiske & Henry Jenkins 3rd edition, Routledge, Oxon 2011
3. An Introduction to communication studies- Sheila Steinberg, Juta & Co., Cape Town, 2007
4. One World Many Voices: Our Cultures - Marilyn Manquis & Sarah Nielsen, Wingspan Press, California, 2010.

Course Code	Project Report Writing	L	T	P	C
SH47O1		3	0	0	3

COURSE OBJECTIVES:

The students should be made to

- Understand the essentials of project writing.
- Perceive the difference between general writing and technical writing
- Assimilate the fundamental features of report writing.
- Understand the essential differences that exist between general and technical writing.
- Learn the structure of a technical and project report.

UNIT I Writing Skills **9**

Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing.

UNIT II Project Report **9**

Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment – Statistical Analysis.

UNIT III Report Structure **9**

Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.

UNIT IV Analysis of Report **9**

Structure of the Project Report: (Part 2) – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations - Recommendations – Conclusion – Bibliography.

UNIT V Presenting a Report **9**

Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Write effective project reports.

CO2: Use statistical tools with confidence.
CO3: Explain the purpose and intension of the proposed project coherently and with clarity.
CO4: Create writing texts to suit achieve the intended purpose.
CO5: Master the art of writing winning proposals and projects.

TEXT BOOKS:

Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall (2012).

REFERENCES:

1. Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012).
2. Daniel Riordan - Technical Report Writing Today (1998) Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers.

Course Code	**Advanced Numerical Methods**	L	T	P	C
SH4702		3	0	0	3

COURSE OBJECTIVE:

- To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology.
- This will also serve as a precursor for future research.

UNIT I Algebraic Equations and Eigenvalue Problem **9**

System of nonlinear equations: Fixed point iteration method - Newtons method; System of linear equations: Thomas algorithm for tri diagonal system - SOR iteration methods ; Eigen value problems: Given's method - Householder method.

UNIT II Interpolation **9**

Central difference: Stirling and Bessel's interpolation formulae ; Piecewise spline interpolation: Piecewise linear, piecewise quadratic and cubic spline ; Least square approximation for continuous data (upto 3rd degree).

UNIT III Numerical Methods for Ordinary Differential Equations **9**

Explicit Adams - Bashforth Techniques - Implicit Adams - Moulton Techniques, Predictor - Corrector Techniques - Finite difference methods for solving two - point linear boundary value problems - Orthogonal Collocation method.

UNIT IV Finite Difference Methods for Elliptic Equations **9**

Laplace and Poisson's equations in a rectangular region : Five point finite difference schemes - Leibmann's iterative methods - Dirichlet and Neumann conditions – Laplace equation in polar coordinates : Finite difference schemes.

UNIT V Finite Difference Method for Time Dependent Partial Differential Equations 9

Parabolic equations : Explicit and implicit finite difference methods – Weighted average approximation - Dirichlet's and Neumann conditions – First order hyperbolic equations – Method of characteristics - Different explicit and implicit methods; Wave equation : Explicit scheme – Stability of above schemes.

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

CO1: Demonstrate the understandings of common numerical methods for nonlinear equations, system of linear equations and eigenvalue problems;
CO2: Understand the interpolation theory;
CO3: Understand the concepts of numerical methods for ordinary differential equations;
CO4: Demonstrate the understandings of common numerical methods for elliptic equations;
CO5: Understand the concepts of numerical methods for time dependent partial differential Equations.

TEXT BOOKS :

1. Grewal, B.S., " Numerical Methods in Engineering & Science & quot;, Khanna Publications, Delhi, 2013.
2. Gupta, S.K., " Numerical Methods for Engineers & quot ;, (Third Edition), New Age Publishers, 2015.
3. Jain, M.K., Iyengar, S.R.K. and Jain, R.K., & quot; Computational Methods for Partial Differential Equations & quot;, New Age Publishers, 1994.

REFERENCES:

1. Saumyen Guha and Rajesh Srivastava, & quot ; Numerical methods for Engineering and Science & quot;, Oxford Higher Education, New Delhi, 2010.
2. Burden, R.L., and Faires, J.D., "Numerical Analysis – Theory and Applications", 9 th Edition, Cengage Learning, New Delhi, 2016.
3. Gupta S.K., "Numerical Methods for Engineers",4th Edition, New Age Publishers, 2019.
4. Sastry, S.S., "Introductory Methods of Numerical Analysis", 5th Edition, PHI Learning, 2015.
5. Morton, K.W. and Mayers D.F., & quot ; Numerical solution of Partial Differential equations & quot;, Cambridge University press, Cambridge, 2002.

Course Code	**Random Processes**	L	T	P	C
SH4703		3	0	0	3

COURSE OBJECTIVES:

The students should be made to

- To introduce the basic concepts of probability, one and two dimensional random variables with applications to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in communication networks
- To acquaint with specialized random processes which are apt for modelling the real time scenario.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

UNIT I Random Variables **9**

Discrete and continuous random variables – Moments – Moment generating functions – Joint Distribution- Covariance and Correlation – Transformation of a random variable.

UNIT II Random Processes **9**

Classification – Characterization – Cross correlation and Cross covariance functions - Stationary Random Processes – Markov process - Markov chain.

UNIT III Special Random Processes **9**

Bernoulli Process – Gaussian Process - Poisson process – Random telegraph process.

UNIT IV Correlation and Spectral Densities **9**

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT V Linear Systems with Random Inputs **9**

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.

CO2: Apply the concept random processes in engineering disciplines.

CO3: Understand and apply the concept of correlation and spectral densities.

CO4: Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.

CO5: Analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS:

1. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4th Edition, New Delhi, 2002.

REFERENCES:

1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.
3. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.
4. Stark. H. and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rd Edition, 2002.
5. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.

Course Code	**Queuing and Reliability Modelling**	L	T	P	C
SH47O4		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering
- To understand the concept of queueing models and apply in engineering.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering
- To study the system reliability and hazard function for series and parallel systems.
- To implement Markovian Techniques for availability and maintainability which opens up new avenues for research

UNIT I Random Processes **9**

Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.

UNIT II Markovian Queueing Models **9**

Markovian queues – Birth and death processes – Single and multiple server queueing models – Little's formula - Queues with finite waiting rooms.

UNIT III Advanced Queueing Models **9**

M/G/1 queue – PollaczekKhinchin formula - M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.

UNIT IV System Reliability **9**

Reliability and hazard functions- Exponential, Normal, Weibull and Gamma failure distribution – Time - dependent hazard models – Reliability of Series and Parallel Systems.

UNIT V Maintainability and Availability **9**

Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems.

45 PERIODS

30 PERIODS LAB
TOTAL: 75 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Enable the students to apply the concept of random processes in engineering disciplines.
CO2: Students acquire skills in analyzing various queueing models.
CO3: Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner
CO4: Students can analyze reliability of the systems for various probability distributions.
CO5: Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.

TEXT BOOKS:

1. Shortle J.F, Gross D, Thompson J.M,Harris C.M., “Fundamentals of Queueing Theory”, John Wiley and Sons, New York,2018.
2. Balagurusamy E., “Reliability Engineering”, Tata McGraw Hill Publishing Company Ltd., New Delhi,2010

REFERENCES:

1. Medhi J, ”Stochastic models of Queueing Theory”, Academic Press, Elsevier, Amsterdam, 2003.
2. Taha, H.A., "Operations Research", 9th Edition, Pearson India Education Services, Delhi, 2016
3. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.

Course Code	Production and Operations Management for Entrepreneurs	L	T	P	C
PR47O1		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To know the basic concept and function of Production and Operation Management for entrepreneurship
- To understand the Production process and planning.
- To understand the Production and Operations Management Control for business owners

UNIT I Introduction to Production and Operations Management 9

Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production / operations management - production as an organisational function, decision making in production Operations research.

UNIT II Production & Operation Systems 9

Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry.

UNIT III Production & Operations Planning 9

Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning

UNIT IV Production & Operations Management Process 9

Process selection with PLC phases- Process simulation tools- Work Study – Significance – Methods, evolution of normal/ standard time – Job design and rating - Value Analysis - Plant Layout: meaning – characters –- Plant location techniques - Types- MRP and Layout Design - Optimisation and Theory of Constraints (TOC)– Critical Chain Project Management (CCPM)- REL (Relationship) Chart – Assembly line balancing- – Plant design optimisation -Forecasting methods.

UNIT V Controlling Production & Operations Management 9

Material requirement planning (MRP)- Concept- Process and control - Inventory control systems and techniques – JIT and Lean manufacturing - Network techniques - Quality Management: Preventive Vs Breakdown maintenance for Quality – Techniques for measuring quality - Control Chart (X, R, p, np and C chart) - Cost of Quality, Continuous improvement (Kaizen) - Quality awards - Supply Chain Management - Total Quality Management - 6 Sigma approach and Zero Defect Manufacturing

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: To understand the basics and functions of Production and Operation Management for business owners
CO2: To learn about the Production & Operation Systems.
CO3: To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.
CO4: To known about the Production & Operations Management Processes in organisations
CO5: To comprehend the techniques of controlling, Production and Operations in industries.

TEXT BOOKS:

1. Chary S.N, Production and Operations Management, TMH Publications, 2010.
2. Terry Hill, Operation Management. Pal Grave McMillan (Case Study).2005.

REFERENCES:

1. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson, 2007
2. Amitabh Raturi, Production and Inventory Management, 2008.
3. Adam Jr. Ebert, Production and Operations Management, PHI Publication, 1992.

Course Code	**Mathematics for Data Analysis**	L	T	P	C
SH4706		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To know various multivariate data analysis techniques for business research
- Understand the process of collecting data and Testing of Multivariate analysis.
- To understand the estimated regression function
- To Know different kind of Model and its uses
- Understand the Advanced Multivariate Techniques.

UNIT I Introduction **9**

Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation.

UNIT II Preparing for Multivariate Analysis **9**

Conceptualization of research model with variables, collection of data –-Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.

UNIT III Multiple Linear Regression Analysis, Factor Analysis **9**

Multiple Linear Regression Analysis – Inferences from the estimated regression function – Validation of the model. -Approaches to factor analysis – interpretation of results

UNIT IV Latent Variable Techniques **9**

Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.

UNIT V Advanced Multivariate Techniques **9**

Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling

45 PERIODS

30 PERIODS LAB

TOTAL:75 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Demonstrate a sophisticated understanding of the concepts and methods; know the exact scopes and possible limitations of each method; and show capability of using multivariate techniques to provide constructive guidance in decision making
CO2: Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
CO3: Show substantial understanding of the real problems; conduct deep analysis using correct methods; and draw reasonable conclusions with sufficient explanation and elaboration.
CO4: Write an insightful and well-organized report for a real-world case study, including thoughtful and convincing details
CO5: Make better business decisions by using advanced techniques in data analytics.

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani “Additive manufacturing technologies”. 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0.
2. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1 56990-582-1.

REFERENCES:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States, 2006, ISBN: 978-1-4614-9842-1.
5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092

Course Code	**Additive Manufacturing**	L	T	P	C
PR47O2		3	0	0	3

COURSE OBJECTIVES: The students should be made

- To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities
- To be acquainted with vat polymerization and material extrusion processes.
- To be familiar with powder bed fusion and binder jetting processes.
- To gain knowledge on applications of direct energy deposition, and material jetting processes.
- To impart knowledge on sheet lamination and direct write technologies

UNIT I Introduction **9**

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain - ASTM/ISO 52900 Classification - Benefits - AM Unique Capabilities - AM File formats: STL, AMF Applications: Building Printing, Bio Printing, Food Printing, Electronics Printing, Automobile, Aerospace, Healthcare. Business Opportunities in AM.

UNIT II Vat Polymerization and Material Extrusion **9**

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Material Extrusion: Fused Deposition Modeling (FDM) - Process-Materials -Applications and Limitations.

UNIT III Powder Bed Fusion and Binder Jetting **9**

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations – Applications

UNIT IV Material Jetting and Directed Energy Deposition **9**

Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process - Material Delivery Materials -Benefits -Applications.

UNIT V Sheet Lamination and Direct Write Technology **9**

Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation. Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities
CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.
CO3: Elaborate the process and applications of powder bed fusion and binder jetting.
CO4: Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes
CO5: Acquire knowledge on sheet lamination and direct write technology.

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0.
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1 56990-582-1.

REFERENCES:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States, 2006, ISBN: 978-1-4614-9842-1.
5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092

Course Code	**New Product Development**	L	T	P	C
PR47O3		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To introduce the fundamental concepts of the new product development
- To develop material specifications, analysis and process.
- To Learn the Feasibility Studies & reporting of new product development.
- To study the New product qualification and Market Survey on similar products of new product development.
- To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT I Fundamentals of NPD **9**

Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud – QFD.

UNIT II Material Specifications, Analysis & Process **9**

Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT III Essentials of NPD **9**

RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Function Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents.

UNIT IV Criterions of NPD **9**

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.

UNIT V Reporting & Forward-Thinking of NPD **9**

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Discuss fundamental concepts and customer specific requirements of the New Product development.
CO2: Discuss the Material specification standards, analysis and fabrication, manufacturing process.
CO3: Develop Feasibility Studies & reporting of New Product development.
CO4: Analyzing the New product qualification and Market Survey on similar products of new product development
CO5: Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model.

TEXT BOOKS:

1. Product Development – Sten Jonsson.
2. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger.

Course Code	**Industrial Design & Rapid Prototyping Design Techniques**	L	T	P	C
PR4704		3	0	0	3

COURSE OBJECTIVES:

The students should be made to

- Understand the outline Fundamental concepts in UI & UX.
- Introduce the principles of Design and Building an mobile app
- Illustrate the use of CAD in product design.
- Outline the choice and use of prototyping tools.
- Understanding design of electronic circuits and fabrication of electronic devices.

UNIT I UI/UX **9**

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Color theory - Design process flow, wireframes, best practices in the industry -User engagement ethics - Design alternatives

UNIT II APP Development **9**

SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

UNIT III Industrial Design **9**

Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation – Assembly - Product design and rendering basics - Dimensioning & Tolerancing

UNIT IV Mechanical Rapid Prototyping **9**

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing

UNIT V Electronic Rapid Prototyping **9**

Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Create quick UI/UX prototypes for customer needs.
CO2: Develop web application to test product traction / product feature.
CO3: Develop 3D models for prototyping various product ideas.
CO4: Built prototypes using Tools and Techniques in a quick iterative methodology.
CO5: Analyze the Electronic Rapid Prototyping.

TEXT BOOKS:

1. Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003) Samar Malik, Autodesk Fusion 360 - The Master Guide.
2. Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, Pearson,3rd edition(2014)

REFERENCES:

1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark.
2. Change by Design.
3. Toyota Product Development System – James Morgan & Jeffrey K. Liker
4. Winning at New Products – Robert Brands 3rd Edition

5. Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar

Course Code	Micro and Precision Engineering	L	T	P	C
PR4705		3	0	0	3

COURSE OBJECTIVES:

At the end of this course the student should be able to

- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other Instruments.
- Learn metrology for micro system.

UNIT I Introduction to Microsystems

Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic magnetic etc for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties, micro-sensors for measurement of pressure, flow, temperature, mertia, force, acceleration, torque, vibration, and motoring of manufacturing systems.

UNIT II Fabrication Processes for Micro Systems

Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro- robot, and miniature biomedical devices

UNIT III Introduction to Precision Engineering

Machine tools, holding and handling devices, positioning fixtures for fabrication assembly of microsystems Precision drives, inch worm motors, ultrasonic motors, stick-slip meclianism and other piezo-based devices.

UNIT IV Precision Machining Processes

Precision machung processes for macro components Diamond turning, fixed and fire abrasive finishing processes abrative processes.

UNIT V Metrology for Micro Systems

Basic principles of measurement in Microsystems- Precision, accuracy, and resolution in microscale measurements -Sensors and transducers for microscale applications- Calibration techniques for microscale devices- Error analysis and uncertainty in microscale measurements.

TOTAL: 45 PERIODS

Course Outcomes:
Upon the completion of this course the students will be able to

1. Select suitable precision machine tools and operate

2. Apply the macro and micro components for fabrication of micro systems.
3. Apply suitable machining process
4. Able to work with miniature models of existing machine tools/robots and other instruments.
5. Apply metrology for micro system

TEXT BOOKS:

1. Davim, J. Paulo, ed. Microfabrication and Precision Engineering: Research and Development.Woodhead Publishing, 2017
2. Gupta K, editor. Micro and Precision Manufacturing. Springer; 2017

Reference Books:

1. Dornfeld, D., and Lee, D. E., Precision Manufacturing, 2008, Springer.
2. H. Nakazawa, Principles of Precision Engineering, 1994, Oxford University Press.
3. Whitehouse, D. J., Handbook of Surface Metrology, Institute of Physics Publishing, Philadelphia PA, 1994.
4. Murthy.R.L, Precision Engineering in Manufacturing!!, New Age International, New Delhi, 2005

Course Code	**Cost Management of Engineering Projects**	L	T	P	C
MG4701		3	0	0	3

COURSE OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control
- Techniques Illustrate with quantitative techniques in cost management

UNIT I Introduction to Costing Concepts

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II Introduction to Project Management

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III Project Execution and Costing Concepts

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV Costing Of Service Sector and Budgetery Control

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V Quantitative Techniques for Cost Management

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon successful completion of the course, students should be able to:

CO1: Understand the costing concepts and their role in decision making.
CO2: Understand the project management concepts and their various aspects in selection.
CO3: Interpret costing concepts with project execution.
CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques.
CO5: Become familiar with quantitative techniques in cost management.

TEXT BOOKS:

1. John M. Nicholas, Herman Steyn Project Management for Engineering, Business and Technology, Taylor & Francis, 2 August 2020, ISBN: 9781000092561.
2. Albert Lester, Project Management, Planning and Control, Elsevier/Butterworth-Heinemann, 2007, ISBN: 9780750669566, 075066956X.

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991.
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988.
3. Charles T. Horngren et al Cost Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi, 2011.
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003.
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007.

Course Code	**Batteries and Management System**	L	T	P	C
EI4709		3	0	0	3

COURSE OBJECTIVES:

- The objective of this course is to make the students to understand the working and characteristics of different types of batteries and their management.

UNIT I Advanced Batteries **9**

Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics SOC, DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries. NCR18650B specifications.

UNIT II Battery Pack **9**

Battery Pack- design, sizing, calculations, flow chart, real and simulation Model. Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

UNIT III Battery Modelling **9**

Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models Introduction. Battery Modelling software/simulation frameworks

UNIT IV Battery State Estimation **9**

SOC Estimation- Definition, importance, single cell Vs series batteries SOC. Estimation Methods Load voltage, Electromotive force, AC impedance, Ah counting, Neural networks, Neuro-fuzzy forecast method, Kalman filter. Estimation Algorithms.

UNIT V BMS Architecture and Real Time Components **9**

Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex RayCANedge1 package. ARBIN Battery Tester. BMS Development with Modeling software and Model Based Design.

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: At the end of this course, students will be able to

CO1: Acquire knowledge of different Li-ion Batteries performance.
CO2: Design a Battery Pack and make related calculations.
CO3: Demonstrate a Battery Model or Simulation.
CO4: Estimate State-of-Charges in a Battery Pack.
CO5: Approach different BMS architectures during real world usage.

TEXT BOOKS

1. Jiuchun Jiang and Caiping Zhang, “Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles’’, Wiley, 2015.
2. Davide Andrea, “Battery Management Systems for Large Lithium-Ion Battery Packs” ARTECH House, 2010.

REFERENCE BOOKS

1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper

2. Panasonic NCR18650B- DataSheet 3. bq76PL536A-Q1- IC DataSheet 4. CC2662R-Q1- IC DataSheet

Course Code	Sensors and Actuators	L	T	P	C
EI4708		3	0	0	3

COURSE OBJECTIVES:

- The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.

UNIT I Introduction to Measurements and Sensors **9**

Sensors: Functions- Classifications- Main technical requirement and trends Units and standards- Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error- Propagation of error- Odds and uncertainty- principle of transduction-Classification. Static characteristics- mathematical model of transducers- Zero, First and Second order transducers- Dynamic characteristics of first and second order transducers for standard test inputs.

UNIT II Variable Resistance and Indutance Sensors **9**

Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT.

UNIT III Variable and Other Special Sensors **9**

Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV Automotive Actuators **9**

Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc.

UNIT V Automatic Temperature Control Actuators **9**

Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: List common types of sensor and actuators used in vehicles.
CO2: Design measuring equipment's for the measurement of pressure force, temperature and flow.
CO3: Generate new ideas in designing the sensors and actuators for automotive application
CO4: Understand the operation of the sensors, actuators and electronic control.
CO5: Design temperature control actuators for vehicles.

TEXT BOOKS:

1. Doebelin's Measurement Systems: 7th Edition (SIE),Ernest O. Doebelin Dhanesh N.Manik McGraw Hill Publishers, 2019.
2. Robert Brandy, " Automotive Electronics and Computer System", Prentice Hall,2001
3. William Kimberley," Bosch Automotive Handbook", 6th Edition, Robert Bosch GmbH, 2004.
4. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5.

REFERENCES:

1. James D Halderman, " Automotive Electrical and Electronics", Prentice Hall, USA, 2013
2. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004, SAE International.
3. Patranabis.D, " Sensors and Transducers", 2nd Edition, Prentice Hall India Ltd,2003
4. William Ribbens, "Understanding Automotive Electronics -An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.

Course Code	**Space Vehicles**	L	T	P	C
PR47O6		3	0	0	3

COURSE OBJECTIVES:

- To interpret the missile space stations, space vs earthj environment
- To explain the life support systems, mission logistics and planning
- To deploy the skills effectively in understanding of space vehicle configuration design
- To explain engine system and support of space vehicle
- To interpret nose cone configuration of space vehicle

UNIT I Fundamental Aspects **9**

Energy and Efficiencies of power plants for space vehicles – Typical Performance Values -Mission design – Structural design aspects during launch – role of launch environment on launch vehicle integrity.

UNIT II Selection of Rocket Propulsion Systems **9**

Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.

UNIT III Engine Systems, Controls and Integration **9**

Propellent Budget – Performance of complete or Multiple Rocket Propellent systems – Engine Design – Engine Controls – Engine system calibration – System Integration and Engine optimization

UNIT IV Thrust Vector Control **9**

TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods – exhaust plume problems in space environment

UNIT V Nose Cone Configuration **9**

Aerodynamic aspects on the selection of nose shape of a launch vehicle – design factors in the finalization of nose configuration with respect to payload – nose cone thermal protection system -separation of fairings – payload injection mechanism

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
CO2: Apply knowledge in selecting the appropriate rocket propulsion systems.
CO3: Interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
CO4: Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
CO5: Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.

TEXT BOOKS:

1. Anderson, J. D., Introduction to Flight, 7th ed., McGraw-Hill (2011).
2. B.N.Suresh, Sivan.K, Integrated Design for Space Transportation System – 1st ed. 2015 edition
3. Basic Flight Mechanics – AshishTewari, Springer, 2016
4. Why Things Don't Fall Down, by J.E. Gordon (Pelican Books, 1979)

REFERENCES:

1. Aircraft Design: A Conceptual Approach by Daniel P. Raymer
2. Campbell, F. C., Manufacturing Technology for Aerospace Structural Materials, Elsevier (2006).
3. Patranabis Turner, M. J. L., Rocket and Spacecraft Propulsion: Principles, Practice and New Developments,3rd ed., Springer (2009).
4. Flight Stability and Automatic Control (Hardcover) by Robert C. Nelson

Course Code	Management Science	L	T	P	C
MG4702		3	0	0	3

COURSE OBJECTIVES:

- To familiarize the students to the basic concepts of management in order to aid in understanding how an organization functions, and in understanding the complexity and wide variety of issues managers face in today's business firms.
- To acquaint the students with the fundamentals of managing business and to understand individual and group behaviour at work place so as to improve the effectiveness of an organization. The course will use and focus on Indian experiences, approaches and cases.

UNIT I Nature and Theories of Management **9**

Evolution of management Thought-Classical, Behavioral and Management Science Approaches Management- meaning, levels, management as an art or science, Managerial functions and Roles, Evolution of Management Theory- Classical era- Contribution of F.W.Taylor, Henri Fayol, Neo-Classical-Mayo & Hawthorne Experiments. • Modern era – system & contingency approach Managerial Skills.

UNIT II Planning and Organising **9**

Planning - Steps in Planning Process - Scope and Limitations - Forecasting and types of Planning - Characteristics of a sound Plan - Management by Objectives (MBO) - Policies and Strategies - Scope and Formulation - Decision Making - Types, Techniques and Processes. Organisation Structure and Design - Authority and Responsibility Relationships - Delegation of Authority and Decentralisation - Interdepartmental Coordination - - Impact of Technology on Organisational design - Mechanistic vs Adoptive Structures - Formal and Informal Organisation. Control: meaning, function, Process and types of Control.

UNIT III Individual Behaviour **9**

Meaning of Organizational behavior, contributing disciplines, importance of organizational behavior, Perception and Learning - Personality and Individual Differences - Motivation theories and Job Performance - Values, Attitudes and Beliefs - Communication Types Process - Barriers - Making Communication Effective.

UNIT IV Group Behaviour **9**

Groups and Teams: Definition, Difference between groups and teams, Stages of Group Development, Group Cohesiveness, Types of teams, Group Dynamics - Leadership - Styles - Approaches - Power and Politics - Organisational Structure - Organisational Climate and Culture, Conflict: concept, sources, Types, Stages of conflict, Management of conflict Organisational Change and Development.

UNIT V Emerging Aspects of Organizational Behaviour **9**

Comparative Management Styles and approaches - Japanese Management Practices Organisational Creativity and Innovation - Organizational behavior across cultures - Conditions affecting cross cultural organizational operations, Managing International Workforce, Productivity and cultural contingencies, Cross cultural communication, Management of Diversity.

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: On completion of course, Students will develop

CO1: Understanding of various management concepts and skills required in the business world
CO2: In-depth knowledge of various functions of management in a real time management context
CO3: Understanding of the complexities associated with management of individual behavior in the organizations
CO4: Develop the skillset to have manage group behaviour in Organizations CO5 Insights about the current trends in managing organizational behavior

Course Code	**Production Planning Ands Control**	L	T	P	C
PR47O7		3	0	0	3

COURSE OBJECTIVE:

The course provides basic concepts of

- In production planning and control
- To aid in for casting and its bottlenecks
- Material requirement planning,
- Different approaches to computer aided process planning
- Shop floor control and in manufacturing sector.

UNIT I Manufacturing Planning and Control **9**

Basic concepts - Types of production System - Functions of production planning and control – problems with Production Planning and Control – Computer Integrated Production Management System - Evolution of the MPC system-Demand management in MPC system and the MPC Environment: Make-to-stock, Assembly - to - order, Make - to –order, Engineer to-order.

UNIT II Forecasting **9**

Forecasting system-Forecasting methods – Single and Double moving average methods – Single and Double exponential smoothing methods – Simple regression method of forecasting - Forecasting Errors.

UNIT III Material Requirement Planning **9**

Basic MRP Concepts – Inputs to the MRP System – Master production Schedule – Bill of Materials, Inventory Record File – MRP Logic – Gross requirements, net requirements, lot sizing – Capacity Requirement Planning (CRP)-Distribution Resource Planning (DRP) - Manufacturing Resource Planning (MRP II).

UNIT IV Computer Aided Process Planning **9**

Need for process planning – Functions of process planning – Approaches to CAPP-Variant process planning – part family search – Generative method of CAPP – Forward and Backward planning – input format – part description methods – CAD Models – Decision Logic – Artificial Intelligence – Knowledge Representation – Databases and Algorithms – Expert Process Planning - Automatic Process Planning-Future trends-Case Studies.

UNIT V Shop Floor Control **9**

Functions of shop floor control – Order Release - Operations scheduling – Job sequencing and Priority rules - order progress – Automatic Identification System - Factory Data Collection system.

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: At the end of this course the students are expected

CO1: To familiarize the students with computer application in various activities of manufacturing, production and control system.
CO2: To apply appropriate principles and strategies of planning and control,
CO3: Forecasting, material requirement planning, process planning concepts
CO4: To equip with computer aided process planning
CO5: Shop floor control into computer integrated manufacturing system.

TEXT BOOKS:

1. Groover M.P., “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.
2. Kant Vajpayee S., “Principles of Computer Integrated Manufacturing”, Prentice Hall of India, 2006.
3. Radhakrishnan P, Subramaniyan S, Raju V,"CAD/CAM/CIM", New Age International Publishers, Reprint 2013.

REFERENCES:

1. Chand T.C., “Expert process planning for manufacturing”, Addison Wesley publishing company, 1990.
2. Groover M.P. and Zimmers E.W., “CAD/CAM, Computer Aided Design and Manufacturing”, Prentice Hall of India, 2006.
3. G. Halevi,R. Weill, "A Logical Approach to process planning”, First Edition, Chapman and Hall, 1995.

Course Code	Operations Management	L	T	P	C
MG4703		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I Introduction to Operations Management **9**

Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy - Strategic fit , framework; Supply Chain Management

UNIT II Forecasting, Capacity and Facility Design **9**

Demand Forecasting - Need, Types, COURSE OBJECTIVES and Steps. Overview of Qualitative and Quantitative methods. Capacity Planning - Long range, Types, Developing capacity alternatives. Overview of sales and operations planning. Overview of MRP, MRP II and ERP. Facility Location – Theories, Steps in Selection, Location Models. Facility Layout – Principles, Types, Planning tools and techniques.

UNIT III Design Of Product, Process and Work Systems **9**

Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Work Study – COURSE OBJECTIVES, Procedure. Method Study and Motion Study. Work Measurement and Productivity – Measuring Productivity and Methods to improve productivity.

UNIT IV Materials Management **9**

Materials Management – COURSE OBJECTIVES, Planning, Budgeting and Control. Purchasing – COURSE OBJECTIVES, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory – COURSE OBJECTIVES, Costs and control techniques. Overview of JIT.

UNIT V Scheduling and Project Management **9**

Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson's Algorithm – Gantt charts; personnel scheduling in services.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm's competitive advantages in the dynamic business environment.
CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.
CO3: The students will able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.
CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.
CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

TEXT BOOKS:

1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations and Supply Management, Tata McGraw Hill, 12th Edition, 2010.
2. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2002.

REFERENCES:

1. William J Stevenson, Operations Management, Tata McGraw Hill, 9 th Edition, 2009.
2. Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006.
3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
4. Chary S. N, Production and Operations Management, Tata McGraw Hill, Third Edition, 2008.
5. Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, Revised Second Edition, 2008.
6. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007.
7. Pannerselvam R, Production and Operations Management, Prentice Hall India, Second Edition, 2008.

Course Code	**Industrial Hyigene**	L	T	P	C
MG47O4		3	0	0	0

COURSE OBJECTIVES:

The students should be made

- To understand the basic safety terms and international standards.
- To learn the safe measures while performing work in and around the work area of the available laboratories. Able to recognize
- To identify the hazards and risk analysis around the work environment and industries.
- To recognise the hazards for its prevention and control.
- To identify the industrial health and hygiene

UNIT I Importance of Safety, Health and Environment **9**

Importance of Safety, health and environment. Health safety and environmental policy, fundamentals of safety, classification of accidents, Managements responsibility, objectives of safety management, National safety council, Employees state insurance act 1948, approaches to prevent accidents, principles of safety management, safety organization, safety auditing, maintenance of safety, measurements of safety performance, industrial noise and noise control, Industrial Psychology, Industrial accidents and prevention. Introduction to OSHAS 18001 and OSHA.

UNIT II Safety Management **9**

Process safety management (P.S.M) as per OSHA, legal aspects of safety, safety with respect to plant and machinery, the explosive act 1884, Petroleum act 1934, personal protective equipment (PPE), classification of hazards, protection of respiratory system, work permit system, hazards in refineries and process plants, safety in process plants, pollution in some typical process industry.

UNIT III Safety and Its Procedures **9**

Safe working practices, housekeeping, safe working environment, safety device and tools, precaution in use of ladders, safety instruction during crane operation, safety instruction for welding, burning and cutting and gas welding equipment, electrical safety, case studies, safety in use of electricity, electric shock phenomena, Occurrence of electric shock, medical analysis of electric shock and its effect, safety procedures in electric plants, installation of Earthing system.

UNIT IV Hazardous Safe **9**

Safety in hazardous area, hazard in industrial zones, classification of industrial enclosures for gases and vapours. Mechanical, Chemical, Environmental and Radiation hazards, Machine guards and safety devices, slings, load limits, lifting tackles and lifting equipment, hydrostatic test, chemical hazards, environmental hazards, devices for measuring radiation, safety analysis and risk analysis, risk management, first aid, Safety measures to avoid occupational diseases.

UNIT V Industrial Health & Hygiene **9**

Introduction & classification of health hazards. Dangerous properties of chemicals, dust, gases, fume, mists, vapours, smoke and aerosols and their health effects. Routes of human entry system, recognition, evolution and control basic hazards, and bio chemical action of toxic substance and toxicity, type and degrees of toxic effects, threshold limits of exposure(TLV), STEL, IDLH, LD/LC etc. Physiology of work and occupational diseases.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the basic safety terms and international standards.
CO2: Use the safe measures while performing work in and around the work area of the available laboratories. Able to recognize the sign boards and its application
CO3: Identify the hazards and risk analysis around the work environment and industries.
CO4: Recognize the hazards for its prevention and control.
CO5: Understand the industrial health and hygiene.

TEXT BOOKS:

1. Deshmukh, L.M "Industrial safety management" first edition, Tata Megraw Hill, New Delhi, 2006.
2. Jain .R.K and Sunil S Rao "Industrial safety health and environment management system, second edition, Khanna Publishers,2008.
3. Industrial Safety and Management L M Deshmukh McGraw Hill Education (India) private Limited ISBN-13: 978-0-07- 061768-1
4. Industrial health and safety management A.M.Sarma Himalya publishing house

REFERENCES:

1. The Environment Act (Protection) 1986 Commercial Law Publishers (India) Pvt. Ltd. New Delhi.
2. Water (Prevention and control of pollution) act 1974 Commercial Law publishers (India) Pvt.

Course Code	**Advanced Java Programming**	L	T	P	C
CY4701		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To provide an overview of working principles of internet, web related functionalities
- To understand and apply the fundamentals core java, packages, database connectivity for computing
- To enhance the knowledge to server side programming.
- To Understand the OOPS concept & how to apply in programming.
- To learn about Networks

UNIT I Java Fundamentals **9**

Java features – Java Platform – Java Fundamentals – Expressions, Operators, and Control Structures – Classes, Methods – Inheritance - Packages and Interfaces – Boxing, Unboxing – Variable-Length Arguments (Varargs), Exception Handling.

UNIT II Collections and Advance Features **9**

Utility Packages- Introduction to collection –Hierarchy of Collection framework – Generics, Array list, LL, HashSet, Treeset, HashMap – Comparators – Java annotations – Premain method.

UNIT III Advanced Javaprogramming **9**

Input Output Packages – Inner Classes – Java Database Connectivity - Introduction JDBC Drivers - JDBC connectivity with MySQL/Oracle -Prepared Statement & Result Set – JDBC Stored procedures invocation - Servlets - RMI – Swing Fundamentals - Swing Classes.

UNIT IV Overview of Data Retrieval & Enterprise Application Development **9**

Tiered Application development - Java Servers, containers –Web Container – Creating Web Application using JSP/Servlets – Web Frameworks Introduction to Spring/ Play Framework – ORM Layer – Introduction to Hibernate.

UNIT V Java Internals and Networking **9**

Java jar Files-Introspection – Garbage collection – Architecture and design – GC Cleanup process, Invoking GC, Generation in GC - Networking Basics Java and the Net – InetAddress – TCP/IP Client Sockets – URL –URL Connection – TCP/IP Server Sockets – A Caching Proxy HTTP Server – Datagrams

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Implement Java programs.
CO2: Make use of hierarchy of Java classes to provide a solution to a given set of requirements found in the Java API
CO3: Use the frameworks JSP, Hibernate, Spring
CO4: Design and implement server side programs using Servlets and JSP
CO5: Implementation of Networking Strategies.

TEXT BOOKS:

1. Amritendu De, “Spring 4 and Hibernate 4: Agile Java Design and Development”, McGraw-Hill Education, 2015.
2. Herbert Schildt, The Complete Reference – Java 2, Ninth Edition, Tata McGraw Hill, 2014

REFERENCES:

1. John Dean, Raymond Dean, “Introduction to Programming with JAVA – A Problem Solving Approach”, Tata Mc Graw Hill, 2014.
2. Mahesh P. Matha, “Core Java A Comprehensive Study”, Prentice Hall of India, 2011
3. R. Nageswara Rao,“Core Java: An Integrated Approach”, DreamTech Press, 2016.

Course Code	Database Management System	L	T	P	C
CY4702		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To learn the fundamentals of data models
- To learn conceptual modeling using ER diagrams.
- To study SQL queries and database programming
- To learn proper designing of relational database.
- To understand database security concepts
- To understand Information retrieval techniques

UNIT I DBMS and Conceptual Data Modeling **9**

Purpose of Database System – Data independence - Data Models – Database System Architecture – Conceptual Data modeling: ER models - Enhanced-ER Model. Introduction to relational databases – Relational Model – Keys – ER-to-Relational Mapping. Modeling of a library management system.

UNIT II Database Querying **9**

Relational Algebra – SQL: fundamentals – DDL – Specifying integrity constraints - DML – Basic retrieval queries in SQL - Complex SQL retrieval queries – nested queries – correlated queries – joins - aggregate functions. Creating a table, populating data, adding integrity constraints, querying tables with simple and complex queries.

UNIT III Database Programming **9**

Database programming with function calls, stored procedures - views – triggers. Embedded SQL. ODBC connectivity with front end tools. Implementation using ODBC/JDBC and SQL/PSM, implementing functions, views, and triggers in MySQL / Oracle.

UNIT IV Database Design **9**

Functional Dependencies – Design guidelines – Normal Forms: first, second, third – Boyce/Codd Normal Form – Normalization algorithms. Design of a banking database system / university database system.

UNIT V Advanced Topics **9**

Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

CO1: Understand relational data model,
CO2: Evolve conceptual model of a given problem,
CO3: Data model mapping to relational model and Normalization
CO4: Query the relational database and write programs with database connectivity
CO5: Understand the concepts of database security and information retrieval systems

TEXT BOOKS:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition , Pearson, 2011.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2011

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, ―Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.

Course Code	**R Programming**	L	T	P	C
CY47O3		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To understand and able to use basic programming concepts
- To automate data analysis, working collaboratively and openly on code
- To know how to generate dynamic documents
- Able to use a continuous test driven development approach

UNIT I Introduction **9**

Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations.

UNIT II Control Structures and Vectors **9**

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations.

UNIT III Lists **9**

Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, OtherMatrix-Like Operations

UNIT IV Factors and Tables **9**

Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables, Extracting a Sub table, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

UNIT V Object-Oriented Programming **9**

S Classes, S Generic Functions, Writing S Classes, Using Inheritance, S Classes, Writing S Classes, Implementing a Generic Function on an S Class, visualization, Simulation, code profiling, Statistical Analysis with R, data manipulation

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: At the end of this course, the students will be able to:

CO1: Study and use basic fundamental concepts to solve the real world problem using R programming language.
CO2: Design and implement the solution using scalar, vectors, matrices and statistical problems in R program.
CO3: Design and implement the program using data frame, list to provide the solution for various problem.
CO4: Study about factors and tables and to solve statistical problems.
CO5: Minimize and maximize functions, simulation and visualization and statistical analysis using R.

TEXT BOOKS:

1. Roger D. Peng," R Programming for Data Science ", 2012
2. Norman Matloff,"The Art of R Programming- A Tour of Statistical Software Design", 2011

REFERENCES:

1. Garrett Grolemund, Hadley Wickham,"Hands-On Programming with R:Write Your Own Functions and Simulations" , 1st Edition, 2014
2. Venables , W.N.,and Ripley,"S programming", Springer, 2000.

Course Code	Data Science Fundamentals	L	T	P	C
CY4704		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To understand the data science fundamentals and process.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.
- To utilize the Python libraries for Data Wrangling.
- To present and interpret data using visualization libraries in Python

UNIT I Introduction **9**

Data Science: Benefits and uses – facets of data – Data Science Process: Overview-Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – build the model– presenting findings and building applications – Data Mining – Data Warehousing – Basic Statistical descriptions of Data

UNIT II Describing Data **9**

Types of Data – Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages – Describing Variability – Normal Distributions and Standard (z) Scores

UNIT III Describing Relationships **9**

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of

UNIT IV Python Libraries for Data Wrangling **9**

Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables

UNIT V Data Visualization **9**

Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting – Geographic Data with Basemap – Visualization with Seaborn.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: At the end of this course, the students will be able to:

CO1: Define the data science process
CO2: Understand different types of data description for data science process
CO3: Gain knowledge on relationships between data
CO4: Use the Python Libraries for Data Wrangling
CO5: Apply visualization Libraries in Python to interpret and explore data

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III)
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)

REFERENCES:

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press,2014.

Course Code	**Advanced Programming in C and Python**	L	T	P	C
CY4705		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- Illustrate about the User defined functions and structure & functions.
- To know about the pointers and file management in C.
- Describe the semantics of Python programming language and Illustrate the process of structuring the data using lists, dictionaries, tuples, strings and sets.
- Illustrate the Object-oriented Programming concepts in Python. Demonstrate the basic database design for storing data as part of a multi-step data gathering, analysis, and processing.
- To analyse biological systems models using MATLAB .Familiarize the basics of machine learning using an approachable, and also understand the advantage of using Python libraries for implementing Machine Learning models.

UNIT I User-Defined Functions & Structures and Unions 9

Introduction, Need for user-defined functions, The form of C function, Return values and their types, Calling a function, category of functions, No arguments and no return values, Argument

with no return values, Arguments with return values, Handling of non-integer functions, Nesting of functions, Recursion, Functions with arrays, The scope and Lifetime of variables in functions. Introduction, Structure definition, Giving values to members, Structure initialization, Comparison of structures variables, Arrays of structures, Arrays within structures, Structures within Structures, Structures and functions, Unions, Size of structures, Bit fields.

UNIT II Pointers & File Management in C **9**

Introduction, Understanding pointers, Accessing the address of a variable, Declaring and initializing pointers, Accessing a variable through its pointer, Pointer expressions, Pointer increments and scale factor, Pointers and arrays, Pointers and character strings, Pointers and Functions, Pointers and structures. File Management in C: Introduction, Defining and opening a file, Closing a file, Input / Output operations on files, Error handling during I/O operations, Random access files, Command line arguments. Dynamic Memory Allocation Introduction, Dynamic Memory allocation, Memory allocation functions The Preprocessors: Introduction, Macro Substitution, File inclusion, Compiler control directives

UNIT III Introduction to Python **9**

Introduction to Python, use IDLE to develop programs, Basic coding skills, working with data types and variables, working with numeric data, working with string data, Python functions, Boolean expressions, selection structure, iteration structure, working with lists, work with a list of lists, work with tuples, work with dates and times, get started with dictionaries

UNIT IV Classes in Python & I/O And Error Handling in Python **9**

OOPS Concepts, Classes and objects , Classes in Python, Constructors, Data hiding, Creating Classes, Instance Methods, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes, Iterators, generators and decorators. Introduction, Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data From a File, Additional File Methods, Handling IO Exceptions, Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions, Working with Directories.

UNIT V An Introduction to Relational Databases & Implement Machine Learning Algorithms: **9**

SQL statements for data manipulation, Using SQLite Manager to work with a database, Using Python to work with a database, Creating a GUI that handles an event, working with components. Usage of Numpy for numerical Data,Usage of Pandas for Data Analysis, Matplotlib for Python plotting, Seaborn for Statical plots, interactive Dynamic visualizations, SciKit for Machine learning.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Implement about the User defined functions and structure & functions.
CO2: Identify about the pointers and file management in C.
CO3: Interpret the basic principles of Python programming language.
CO4: Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python & Identify the commonly used operations involving file systems and regular expressions.
CO5: Implement database and GUI applications & Machine Learning algorithms

TEXT BOOKS:

1. Programming in ANSI C, Balagurusamy, Tata McGraw-Hill
2. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
3. Mark Lutz, Programming Python, O`Reilly, 4th Edition, 2010

REFERENCES:

1. Programming in C, by Pradip Dey & Manas Ghosh, Publisher – Oxford 3. Let Us C , Yashwant Kanetkar, BPB Publications
2. The Complete Reference, Herbert schildt Fourth Edition
3. Let Us C , Yashwant Kanetkar, BPB Publications

Course Code	**Advanced Data Security**	L	T	P	C
CY47O6		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To learn cybercrime and cyberlaw.
- To understand the security attacks and tools for mitigating them.
- To understand information gathering
- To learn how to detect a security attack.
- To learn how to prevent a security attack.

UNIT I Introduction **9**

Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

UNIT II Attacks and Counter Measures **9**

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.

UNIT III Reconnaissance **9**

Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap

Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques.

UNIT IV Intrusion Detection **9**

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

UNIT V Intrusion Prevention **9**

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Explain the basics of cyber security, cyber crime and cyber law (K2)
CO2: Classify various types of attacks and learn the tools to launch the attacks (K2)
CO3: Apply various tools to perform information gathering (K3)
CO4: Apply intrusion techniques to detect intrusion (K3)
CO5: Apply intrusion prevention techniques to prevent intrusion (K3)

TEXT BOOKS:

1. Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021 (Unit 1)
2. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley Publishers, 2011 (Unit 1)
3. https://owasp.org/www-project-top-ten/

REFERENCES:

1. David Kim, Michael G. Solomon, “Fundamentals of Information Systems Security”, Jones & Bartlett Learning Publishers, 2013 (Unit 2)
2. Patrick Engebretson, “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy”, Elsevier, 2011 (Unit 3)
3. Kimberly Graves, “CEH Official Certified Ethical hacker Review Guide”, Wiley Publishers, 2007 (Unit 3)
4. William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, Third Edition, Pearson Education, 2015 (Units 4 and 5)
5. Georgia Weidman, “Penetration Testing: A Hands-On Introduction to Hacking”, No Starch Press, 2014 (Lab)

Course Code	Software Engineering	L	T	P	C
CY4707		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To understand the phases in a software development project
- To learn project management concepts
- To understand the concepts of requirements analysis and modeling.
- To understand software design methodologies.
- To learn various testing methodologies

UNIT I Software Process **9**

Introduction to Software Engineering, scope – software crisis – principles of software engineering - Software process – Life cycle models – Traditional and Agile Models - Team organization.

UNIT II Planning and Estimation **9**

Planning and the software process – cost estimation: LOC, FP Based Estimation, COCOMO I & II Models – Duration estimation and tracking – Gantt chart - Software Project Management – plan – risk analysis and management.

UNIT III Requirements Analysis and Specification **9**

Software Requirements: Functional and Non-Functional, Software Requirements specification– Structured system Analysis – modeling: UML based tools, DFD - Requirement Engineering Process.

UNIT IV Software Design and Implementation **9**

Design process – Design principles and guidelines – design techniques – coupling and cohesion - metrics – tools. Implementation: choice of programming language, programming practices – coding standards – code walkthroughs and inspections.

UNIT V Testing and Maintenance **9**

Software testing fundamentals- Testing techniques: white box, black box, glass box testing - unit testing – integration testing –system testing – acceptance testing – debugging. Post-delivery maintenance: Types – objectives - metrics - Reverse Engineering.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand different software life cycle models.
CO2: Perform software requirements analysis
CO3: Apply systematic methodologies for software design and deployment.
CO4: Understand various testing approaches and maintenance related issues.
CO5: Plan project schedule, and estimate project cost and effort required.

TEXT BOOKS:

1. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Seventh Edition, Mc Graw-Hill International Edition, 2010.
2. Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.

REFERENCES:

1. Rajib Mall, "Fundamentals of Software Engineering", Third Edition, PHI Learning Private Limited, 2009.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010
3. Kelkar S.A., "Software Engineering", Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, "Software Engineering", Tata McGraw-Hill Publishing Company Limited, 2007.

Course Code	**Cloud Computing**	L	T	P	C
CY47O8		3	0	0	3

COURSE OBJECTIVES:

The students should be made

- To learn about the concept of cloud and utility computing
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.
- To Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud

UNIT I Introduction to Cloud Computing **9**

Introduction to Cloud Computing – Roots of Cloud Computing – Desired Features of Cloud Computing – Challenges and Risks – Benefits and Disadvantages of Cloud Computing.

UNIT II Virtualization **9**

Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor – Seven Layers of Virtualization – Types of Virtualization – Server, Desktop, Application Virtualization.

UNIT III Cloud Architecture, Services and Storage **9**

NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage.

UNIT IV Resource Management and Security in Cloud **9**

Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.

UNIT V Case Studies **9**

Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS) – GAE Applications – Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
CO2: Learn the key and enabling technologies that help in the development of cloud.
CO3: Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
CO4: Explain the core issues of cloud computing such as resource management and security
CO5: Be able to install and use current cloud technologies.

TEXT BOOKS:

1. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, First Edition, John Wiley & Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, “Cloud Computing: Implementation, Management, And Security”, CRC Press, 2017.

REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach”, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly, 2009.

Course Code	Design Culture and Services to Parcel	L	T	P	C
SH4707		3	0	0	3

OBJECTIVE:

- To provide an insight on the fundamentals of supply chain networks, tools and techniques

UNIT I Introduction **9**

Role of Logistics and Supply chain management: Scope and importance-Evolution of supply chain-Decision phases in supply chain-Competitive and supply chain strategies- Drivers of supply chain performance and obstacles

UNIT II Supply Chain Network Design **9**

Role of distribution in supply chain- Factors influencing distribution network design- Design options for distribution network in practice- Role of network design in supply chain- Framework for network decisions

UNIT III Logistics in Supply Chain **9**

Role of transportation in supply chain- factors affecting transportation decisions- Design option for transportation network- Tailored transportation- Routing and scheduling in transportation.

UNIT IV Sourcing and Coordination in Supply Chain **9**

Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration-sourcing planning and analysis- supply chain co-ordination- Bull whip effect- Effect of lack of coordination in supply chain and obstacles- Building strategic partnerships and trust within a supply chain.

UNIT V Supply Chain and Information Technology **9**

The role of IT in supply chain- The supply chain IT frame work customer relationship management- Internal supply chain management- supplier relationship management- future of IT in supply chain- E-business in supply chain

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOME: The student would understand the framework and scope of supply chain networks and functions

CO1: Understand the fundamentals logistics
CO2: Enumerate the role of supply chain
CO3: Analyze the role of transport
CO4: Analyse the sourceing and suppliers
CO5: Analyse the role of IT and datadesign

TEXTBOOK:

1. Sunil Chopra, Peter Meindl and Kalra, “Supply Chain Management, Strategy, Planning, and Operation”, Pearson Education, 2010.

REFERENCES:

1. Jeremy F.Shapiro, “Modeling the Supply Chain”, Thomson Duxbury, 2002.
2. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management, PHI, 2010
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, “Logistics”, PHI 2002.
4. James B.Ayers, “Handbook of Supply Chain Management”, St.Lucle press, 2000.

APPENDIX C: MANDATORY COURSES

S.No.	Course Title	Semester	L-T-P-C
1	Introduction to Women and Gender Studies	III	2-0-0-0
2	Elements for Literature	III	2-0-0-0
3	Film Appreciation	III	2-0-0-0
4	Disaster Management	III	2-0-0-0
5	Design Thinking	III	2-0-0-0
6	Environmental Science and Sustainability	IV	2-0-0-0
7	Well Being with Traditional practices (Yogam Ayurveda and Siddha)	IV	2-0-0-0
8	History of Science and Technology in India	IV	2-0-0-0
9	Political and Economic Thought for a Humane Society	IV	2-0-0-0
10	State, Nation building and Politics in India	IV	2-0-0-0
11	Industrial Safety	IV	2-0-0-0

Mandatory Courses – I

Course Code	INTRODUCTION TO WOMEN AND GENDER STUDIES	L	T	P	C
MC4301		2	0	0	0

COURSE OBJECTIVES:

- Understand the difference between sex and gender, including masculinity and femininity, shaped by societal norms.
- Critique patriarchal systems and hierarchies, advocating for the deconstruction of binary views and recognition of gender diversity.
- Engage with various feminist frameworks to analyze and address gender inequality.
- Trace the development and impact of feminist movements globally, nationally, and locally.
- Analyze language, media, and narratives to understand and challenge gender norms and stereotypes.

UNIT I CONCEPTS 2

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY 2

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL 2

Rise of Feminism in Europe and America, Women's Movement in India.

UNIT IV GENDER AND LANGUAGE 2

Linguistic Forms and Gender, Gender and narratives.

UNIT V GENDER AND REPRESENTATION 2

Advertising and popular visual media, Gender and Representation in Alternative Media, Gender and social media.

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

CO1: Mastery of key gender studies concepts, including sex vs. gender, patriarchy, and power dynamics.

CO2: Ability to critically evaluate societal norms and gender roles, recognizing and deconstructing stereotypes.

CO3: Application of diverse feminist theories to address gender inequality on local, national, and global scales.

CO4: Understanding of the historical progression and impact of feminist movements on social attitudes and policies.

CO5: Development of effective communication skills to advocate for gender equality, challenging norms in language, media, and society architecture and how different ARM processors work.

Text Books & References:

To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper

Course Code	ELEMENTS OF LITERATURE	L	T	P	C
MC4302		2	0	0	0

COURSE OBJECTIVES:

- To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience

UNIT I RELEVANCE OF LITERATURE 2

Enhances Reading, thinking, discussing and writing skills, Develops finer sensibility for better human relationship, Increases understanding of the problem of humanity without bias, Providing space to reconcile and get a cathartic effect.

UNIT II ELEMENTS OF FICTION 2

Fiction, fact and literary truth, Fictional modes and patterns, Plot character and perspective.

UNIT III ELEMENTS OF POETRY 2

Emotions and imaginations, Figurative language, Simile, metaphor, conceit, symbol, pun and irony, Personification and animation, Rhetoric and trend.

UNIT IV ELEMENTS OF DRAMA 2

Drama as representational art, Content mode and elements, Theatrical performance, Drama as narration, mediation and persuasion, Features of tragedy, comedy and satire.

UNIT V TUTORIALS 2

The students will write a term paper to show their understanding of a particular piece of literature

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities

Text Books:

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.

References:

1. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press,1991.
2. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.

Course Code	FILM APPRECIATION	L	T	P	C
MC4303		2	0	0	0

COURSE OBJECTIVES:

- Understand filmmaking components, including equipment and storytelling.
- Trace film language evolution, focusing on significant milestones.
- Explore film theories (realist, auteurist, psychoanalytic, feminist).
- Analyze representative films from diverse cultural contexts.
- Examine Indian cinema's development, from early era to regional diversity..

UNIT I THE COMPONENT OF FILMS 2

The material and equipment, The story, screenplay and script, The actors, crew members, and the director, The process of film making, Structure of a film

UNIT II EVOLUTION OF FILM LANGUAGE 2

Film language, form, movement etc, Early cinema, Silent film (Particularly French), The emergence of feature films: Birth of a Nation, Talkies

UNIT III FILM THEORIES AND CRITICISM/APPRECIATION 2

Realist theory: Auteurists, Psychoanalytic, Ideological, Feminists, How to read films? Film Criticism / Appreciation

UNIT IV DEVELOPMENT OF FILMS 2

Representative Soviet films, Representative Japanese films, Representative Italian films, Representative Hollywood film and the studio system.

UNIT V INDIAN FILMS 2

The early era, The important films made by the directors, The regional films, The documentaries in India

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

CO1: Gain a comprehensive understanding of filmmaking components and techniques

CO2: Explore the historical evolution of film language and major milestones.

CO3: Develop critical analysis skills through the study of various film theories.

CO4: Broaden cultural awareness by analyzing representative films from diverse contexts.

CO5: Appreciate the development and diversity of Indian cinema

Text Books:

A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these

Course Code	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
MC4304		2	0	0	0

COURSE OBJECTIVES:

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 2

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR) 2

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources

UNIT III DISASTER MANAGEMENT 2

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 2

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES 2

Discussion on selected case studies to analyze the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill -

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to
CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)
CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction
CO3: To develop disaster response skills by adopting relevant tools and technology
CO4: Enhance awareness of institutional processes for Disaster response in the country
CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

Text Books:

1.Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications

References:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.

Course Code	**Design Thinking**	L	T	P	C
MC4305		2	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

- Introduce students to the fundamental concepts and principles of design thinking.
- Develop students' ability to empathize with users and identify their needs.
- Equip students with skills for problem-solving and generating innovative solutions.
- Foster collaboration and interdisciplinary teamwork among students.
- Apply design thinking methodologies to real-world engineering challenges.

Course Description

This course offers an exploration of the principles and methodologies behind design thinking, emphasizing on a human-centered approach to innovation and problem-solving. Through a blend of lectures, hands-on exercises, and interactive workshops, participants learn to empathize with users, define problems, generate creative solutions, and iterate on prototypes.

UNIT I Introduction to Design Thinking **2**

Definition and principles of design thinking – Importance and applications in engineering – Case studies of successful design thinking projects

UNIT II Empathize and Define **2**

Understanding user needs and motivations – Techniques for empathetic research (interviews, observations, etc.) – Defining problem statements based on user insights

UNIT III Ideate and Prototype **2**

Techniques for generating ideas (brainstorming, mind mapping, etc.) – Prototyping methods and tools – Iterative design process and feedback loops

UNIT IV Test and Iterate **2**

User testing and feedback collection – Analyzing and interpreting feedback – Iterating on prototypes based on feedback

UNIT V Application and Workshop **2**

Applying design thinking to engineering challenges – Workshop sessions for hands-on practice – Presentation (Posters / PPT / Demonstration) of final projects and reflection on the design process

Workshop Ideas:

1. Design Sprints: Conduct short, intensive workshops where students work collaboratively to solve a specific problem within a constrained timeframe.
2. Design Challenges: Pose open-ended design challenges to students and facilitate group work sessions where they brainstorm and prototype solutions.
3. User Persona Creation: Have students create user personas based on research findings and use them to guide the design process.
4. Prototyping Sessions: Provide materials and tools for students to create rapid prototypes of their ideas, encouraging experimentation and creativity.
5. Design Critiques: Organize sessions where students present their prototypes to peers for feedback and constructive criticism, fostering a culture of iteration and improvement.

Course Format

Lectures and discussions, Workshops, Group discussions and presentations,

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the principles and process of design thinking.
CO2: Identify user needs through empathetic research.
CO3: Generate creative ideas and solutions through brainstorming and prototyping.
CO4: Apply design thinking methodologies to solve engineering problems effectively.
CO5: Work collaboratively in multidisciplinary teams to address complex challenges.

TEXT BOOKS:

1. Tim Brown, "Change by Design", Revised and Updated, Harper, 2019.
2. Christian Müller-Roterberg, “Handbook of Design Thinking: Tips & Tools for How to Design Thinking”, Independently Published, 2018.
3. Jeanne Liedtka, and Tim Ogilvie, “Designing for Growth: A Design Thinking Tool Kit for Managers”, Columbia University Press, 2011.

REFERENCES:

1. Don Norman, “The Design of Everyday Things”, Basic Books, 2015.
2. Hasso Plattner, Christoph Meinel, and Larry Leife (editors), “Design Thinking: Understand – Improve – Apply”, Springer-Verlag, 2013.
3. Richard Banfield, C. Todd Lombardo and Trace Wax, “Design Sprint: A Practical Guidebook for Building Great Digital Products”, O'Reilly Media, 2015.

TOTAL: 10 PERIODS

Mandatory Courses – II

Course Code	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY	L	T	P	C
MC4401		2	0	0	0

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY **2**

Definition, scope and importance of environment – need for public awareness. Ecosystem and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION **2**

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III RENEWABLE SOURCES OF ENERGY **2**

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT **2**

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES **2**

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL : 10 PERIODS

Course Outcomes:

Upon Completion of the course the students will be able to

CO1: To recognize and understand the functions of the environment, ecosystems and biodiversity and their conservation.

CO2: To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

CO3: To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4: To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

CO5: To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

Text Books:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

References:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . edition 2010
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai,2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition,2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

Course Code	WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA	L	T	P	C
MC4402		2	0	0	0

COURSE OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE 2

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health – Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health – Environmental health - Occupational/Professional heath.
Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.
Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes – Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues. Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) – Maintaining BMI-Importance and actions to be taken

UNIT II DISASTER RISK REDUCTION (DRR) 2

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.
Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water. Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 2

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy. Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.
Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory – Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal Prevention of illness with our traditional system of medicine
Primary Prevention - To decrease the number of new cases of a disorder or illness – Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention – To decrease the amount of disability associated with an existing disorder

UNIT IV MENTAL WELLNESS **2**

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions. Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement. Sleep - Sleep and its importance for mental wellness - Sleep and digestion. Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 2

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

CO1:Embrace enjoyable, health-promoting activities to foster happiness and well-being.
CO2: Adopt lifestyle changes aimed at preventing various health issues.
CO3: Cultivate emotional resilience to navigate life's challenges with ease.
CO4: Learn to incorporate cost-effective, nutrient-rich foods into daily dietary habits.
CO5: Enhance natural immunity to bolster resistance against a range of health disorders

Text Books:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

References:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
2. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

Course Code	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	L	T	P	C
MC4403		2	0	0	0

COURSE OBJECTIVES:

- Understand key historical concepts and perspectives relevant to the study of science and technology in India.
- Explore the historiography of Indian science and technology through the works of influential historians.
- Trace the development of science and technology in ancient and medieval India, including interactions with other civilizations.
- Analyze the impact of colonialism on Indian science and technology, including responses to Western influence.
- Examine the growth of techno-scientific institutions in colonial India

UNIT I CONCEPTS AND PERSPECTIVES 2

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA 2

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA 2

Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA 2

Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest

UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA 2

Science and the Empire Indian response to Western Science Growth of techno-scientific institutions

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

CO1: Understand historical concepts in the context of Indian science and technology.
CO2: Explore diverse historiography of Indian science and technology.
CO3: Trace the development of science and technology in ancient and medieval India
CO4: Analyze the impact of colonialism on Indian science and technology
CO5: Develop critical thinking skills to assess the relationship between science, technology, and society in India's history

Text Books:

1.A Social History of Indian Science" by Dhruv Raina
2. Science and Society in Early India" by D.P. Chattopadhyaya

References:

1. History of Science and Technology in India: Vol 1-5" by Debiprasad Chattopadhyaya
2. Science, Technology, Imperialism, and War" by Debiprasad Chattopadhyaya

Course Code	POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY	L	T	P	C
MC4404		2	0	0	0

COURSE OBJECTIVES:

- This course will begin with a short overview of human needs and desires and how different political-economic systems try to fullfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions

UNIT I CAPITALISM 2

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies imperialism. Liberal democracy

UNIT II COMMUNISM 2

Fascism and totalitarianism. World war I and II. Cold war. Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.

UNIT III WELFARE STATE 2

Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures) Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature

UNIT IV ESSENTIAL ELEMENTS OF INDIAN CIVILIZATION 2

Technology as driver of society, Role of education in shaping of society. Future directions. (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)

UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA 2

Science and the Empire Indian response to Western Science Growth of techno-scientific institutions

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to:

The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.

Text Books:

1. Adam Smith, J.S.MILL

References:

1. A Nagaraj, M K Gandhi, JC Kumarappa

Course Code	STATE, NATION BUILDING AND POLITICS IN INDIA	L	T	P	C
MC4405		2	0	0	0

COURSE OBJECTIVES:

The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

UNIT I CONCEPTS AND PERSPECTIVES 2

Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world.

UNIT II ORGANS OF STATE 2

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary-federal, Presidential-Parliamentary, The idea of India.

UNIT III NATIONAL AWAKENING 2

1857 and the national awakening. 1885 Indian National Congress and development of national movement – its legacies.

UNIT IV CONSTITUTION 2

Constitution making and the Constitution of India. Goals, objective and philosophy. Need for a Federal system

UNIT V NATIONAL INTEGRATION AND NATION-BUILDING 2

Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario.

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to:

It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

Text Books:

1.Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.

2.Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.

References:

1.Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
2.Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.

Course Code	INDUSTRIAL SAFETY	L	T	P	C
MC4406		2	0	0	0

COURSE OBJECTIVES:

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES 2

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS 2

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES 2

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY 2

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES 2

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

CO1:Understand the basic concept of safety.
CO2:Obtain knowledge of Statutory Regulations and standards.
CO3:Know about the safety Activities of the Working Place.
CO4:Analyze on the impact of Occupational Exposures and their Remedies
CO5:Obtain knowledge of Risk Assessment Techniques

Text Books:

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

References:

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008)Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach
4. Alan Waring.(1996).Safety management system: Chapman &Hall, England
5. Society of Safety Engineers, USA

Appendix D

Course Code	NCC Credit Course	L	T	P	C
		2	0	0	2

UNIT I NCC General **6**

Aims, Objectives & Organization of NCC (1) – Incentives (2) – Duties of NCC Cadet (1) – NCC Camps: Types & Conduct (2)

UNIT II National Integration and Awareness **4**

National Integration: Importance & Necessity (1) – Factors Affecting National Integration (1) – Unity in Diversity & Role of NCC in Nation Building (1) –Threats to National Security (1)

UNIT III Personality Development **7**

Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving (2) – Communication Skills (3) – Group Discussion: Stress & Emotions (2)

UNIT IV Leadership **5**

Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code (3) – Case Studies: Shivaji, Jhansi Ki Rani (2)

UNIT V Social Service and Community Development **8**

Basics, Rural Development Programmes, NGOs, Contribution of Youth (3) – Protection of Children and Women Safety (1) Road/ Rail Travel Safety (1) – New Initiatives (2) – Cyber and Mobile Security Awareness (1)

TOTAL: 30 PERIODS

Levels:

Level	**Activities**
1 ARMY	II semester: The NCC cadets are fresh to NCC activities are provided with above curriculum / syllabus
2 NAVY	For the Higher semester cadets of IV semester the credits are awarded with the basic qualifying needs a) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) b) Appeared for B Certificate Exam
3 AIR FORCE	For the Higher semester cadets of VI semester the credits are awarded with the basic qualifying needs a) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) b) Appeared for C Certificate Exam