Scheme of Studies & Syllabus

Master of Technology
Civil Engineering
2021

Department of CEE

SCHOOL OF ENGINEERING & TECHNOLOGY

THE NORTHCAP UNIVERSITY, GURGAON

(Established under Haryana Govt. Notification No. Leg. 32/2006-HARYANA ACT No.25 of 2009)

Department of Civil & Environmental Engineering

The department of Civil & Environmental Engineering offers the following programmes during the academic year 2021-22.

- Master of Technology (M.Tech.) in Civil Engineering with specialization in
  - Structural Engineering
  - Construction Engineering & Management and
  - Environmental Engineering

M.Tech. in Civil Engineering programme for working professional will impart research based knowledge in the selected disciplines of civil engineering. The programme will be of 3 years with 6 semesters for working professional under part time. The programme has total credits of 57. The curriculum is designed in such a way that there are subjects relevant to overall civil engineering and specialization based seminar, minor project, and dissertation in structural engineering, Construction engineering and Management, and Environmental engineering. Students can opt for any one of these specializations by taking the seminar, minor project and dissertation in those specializations.

PROGRAMME OUTCOMES

- Attain in-depth knowledge of the specialization with an ability to demonstrate the same to solve real life practical problems.
- Independently carry out research and development work in the key areas of the specialization.
- Able to identify and analyse the impact of specialization in development projects and find a suitable sustainable solution
- Conceptualize and apply appropriate techniques, resources and modern engineering tools in solving multidisciplinary problems.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

- Ability to apply knowledge in respective specialized area for proposing methods and solution for different types of problems and challenges.
- To understand modern and latest technologies and apply the conceptualized knowledge in the respective area of specialization.

Department of CEE
M. Tech in Civil Engineering
(with specialization in Structural Engineering / Construction Engineering and Management/ Environmental Engineering)
2021

Semester	Course Code Course Name				Lecture Course	L	T	P	Week Cont. Hrs	Credits
I	CEL501 Sustainable Built Environment 2-1-0 (3)	CEL511 Advanced Foundation Engg 2-1-0(3)	CEL505 Optimization Techniques in Civil Engineering 2-1-0 (3)	CEP501 Laboratory Training, I 0-0-4 (2)	3	6	3	4	13	11
II	CEL503 Safety and Reliability Analysis 2-1-0 (3)	CEL504 Advanced Concrete Technology 2-1-0 (3)	CEL512 Construction Planning Cost Dynamics and Management 2-1-0 (3)	CEP502 Laboratory Training, II 0-0-4 (2)	3	6	3	4	13	11
III	CEL502 EI&RA 2-1-0 (3)	OE-1 2-1-0 (3)	CEC501 Seminar (Specialization based) 0-0-2 (1)		2	4	2	2	8	7
IV	MAL616 Research Methodology 2-1-0 (3)	CEL514 Technical Writing Skills 2-0-0 (2)	CED 512 Minor Project (Specialization based) 0-0-8 (4)		2	4	1	8	13	9
V	OE-2 2-1-0 (3)	CED601 Dissertation Part-I (Specialization based) 0-0-12 (6)			1	2	1	12	15	9
VI	CED602 Dissertation Part-II (Specialization based) 0-0-20(10)				0	0	0	20	20	10
	Total									57

*Open electives can be chosen from the list of Open Elective courses offered by the University. These may be run as Regular or MOOC (full/blended).

M. Tech (Civil Engineering)

CEL501 Sustainable Built Environment
3 Credits (2-0-2)
Background terms; Smart Growth, smart city and New Urbanism and the Resistance to Change; Green Building Assessment; Green Building Index; Life Cycle Costing; The Setting/Green Roofs, Case Study; Energy and Buildings; Energy and Hydrologic Systems; Materials/Specifications; Interior Environments (lighting, air), GRIHA, LEEDs rating system, BEE Standards and guidelines.

CEL502 Environmental Impact & Risk Assessment
3 Credits (2-0-2)
Planning and Management of Environmental Impact Studies. Impact indentation methodologies: base line studies, screening, scooping, checklist, networks, overlays. Prediction and assessment of impacts on the socio-economic environment. Environmental cost benefit analysis. Decision methods for evaluation of alternatives. Case Studies. Environmental impact assessment at project level, regional level, sectoral level, and policy level. Sustainable development; Environmental policy in planned, mixed and market economies; global environmentalism. Preventive environmentalism. Preventive environmental management.

CEL503 Safety and Reliability Analysis
3 credits (2-0-2)
Fundamentals of set theory and probability, probability distribution, regression analysis, hypothesis testing. Stochastic process and its moments and distributions, Concepts of safety factors, Safety, reliability and risk analysis, first order and second order reliability methods, simulation based methods, confidence limits and baysean revision of reliability, reliability based design, examples of reliability analysis of structures

CEL504 Advanced Concrete Technology
3 Credits (2-0-2)
Concrete Making Materials Aggregates – Classification, IS specifications, Properties, Grading, Methods of combining aggregates, specified grading, Testing of aggregates. Cement Chemical composition, Hydration of cement, structure of hydrated cement, special cements, and water chemical admixtures. Concrete

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and Shrinkage, Variability of concrete strength. Mix Design Principles of concrete mix design, Methods of concrete mix design, testing of concrete. Special Concretes Light weight concrete, Fiber reinforced concrete, Polymer concrete, Super plasticized concrete, Properties and applications. Concreting Methods Process of manufacturing of concrete. Methods of Transportation, placing and curing. Extreme weather concreting, special concreting methods.

CEL505 Optimization Techniques in Civil Engineering
3 Credits (2-0-2)
Optimization Introduction – Formulation of LPP – Geometry of LPP and Graphical Solution of LPP – Solution of LPP: Simplex Method – Big M Method – Two Phase Method – Special cases in simple applications – Introduction to Duality Theory – Dual Simplex Method – Optimization of Transportation Problems – Project Management – Path Analysis

CEL511 Advanced Foundation Engineering
Introduction to Foundation Engineering, Soil Exploration, Classification of foundations, Bearing Capacity Theories, Scale Effect, Eccentrically loaded footing, Bearing capacity of- Interfering footings, Anisotropic foundations, Centric inclined load, Oblique loading, Design of Shallow Rigid Foundations, Flexible Design of Foundations: Beams on Elastic Foundation, Finite Difference Schemes and Expressions for various applied loadings and moments, Settlement and Contact pressures, Pile Foundations

CEL512 Construction Planning, cost dynamics and Management
Construction Technology and planning, Construction Economics and finance, Construction Management, Construction Health and Safety, Project Management.

MAL 616 Research Methodology
3 credits (2-1-0)
Foundations of Research, Scientific Research, Motivation, Research Objectives, Research Designs, Research Processes, Understanding Feasibility of Objectives and Processes, Qualitative and Quantitative Research Methods, Data Collection Processes, Biases in Data Collection, Data Pre-processing, Sampling Distribution and Confidence Intervals, Hypothesis Testing, Interpretation of Results, Literature Review, Technical Writing, Citations, Reference management software, Plagiarism, Software for Detection of Plagiarism.

CEL514 Technical Writing skills

Types of technical writing, definition writing and analysis of material, description of mechanisms and processes, library resources, research techniques, and proposal writing, collecting notes, writing outlines, and writing rough drafts, the elements of the formal research report, graphic aids in technical reports, grammar, technical writing style, and paper revision, plagiarism and professional ethics.

CEC532 Seminar
2 Credits (0-2-0)
Independent study on any recent research area in the domain of Civil Engineering as per the specialization chosen by the student. Research papers on specialized topics will be collected from journals and presented. A report shall be submitted showing the literature reviewed by the student.

CED534 Minor project
4 credits
The minor project will be a design project (hardware/software) on a topic suggested by the course coordinator to be completed during the designated duration. It may be of practical and theoretical interest. It has to be done under the guidance of a faculty and students are expected to complete literature survey, feasibility testing, develop or implement the research work.

CEP501 Laboratory Training I
2 Credits
This is a lab/practical course and the lab experiments of core courses running in that semester will be conducted under this laboratory training.

CEP502 Laboratory Training II
2 Credits
This is a lab/practical course and the lab experiments of core courses running in that semester will be conducted under this laboratory training.

CED601 Dissertation Phase-I
6 Credits (0-0-12)
Part-I of the project will cover the problem identification along with the assigned supervisor in the area of specialization followed by literature review, data collections and data generations and identification of the tool of analysis, simulation and modeling and hypothesis for the problem solving.

CED602 Dissertation Phase-II
12 Credits (0-0-24)
Part-II of the project will cover the actual simulation, modeling, result generation and reaching to the desired goal set in Part-I

Department of Mechanical Engineering

The department of Mechanical Engineering offers the following programs during the academic year 2021-22.

Master of Technology (M.Tech)

- Mechanical Engineering with specialization in Thermal Engineering.
- Mechanical Engineering with specialization in Mechanical Engineering Design.
- Mechanical Engineering with specialization in Production and Industrial Engineering.

Bachelor of Technology (B. Tech)

- Mechanical Engineering with specialisation in Robotics and Automation.

M.Tech in Mechanical Engineering programme for working professionals will impart research-based knowledge in the selected disciplines of mechanical engineering. The programme will be of 3 years with 6 semesters for working professionals under part-time. The programme has total credits of 57. The curriculum is designed in such a way that there are subjects relevant to overall mechanical engineering and specialization-based seminar, minor project, and dissertation in three specializations mentioned above. Students can opt for any one of these specializations by taking the seminar, minor project and dissertation in those specializations.

The NorthCap University is one of the best places to get a B Tech Mechanical in Delhi NCR, and the specialization in Robotics and Automation Engineering course offers students the opportunity to learn new and disruptive technologies and enable them to develop innovative instruments to monitor, manipulate, and control systems. With one of the best private engineering colleges in the NCR region, students will use fundamental concepts of the theory of mechanism, microsensors, and actuators and develop humanoid robots, intelligent control systems, and flexible manipulators. The students will graduate with special skill sets and values to achieve professional goals in process automation and robotics. The B. Tech programme will be of 4 years duration with 8 semesters under regular mode and has a total credit of 175.

DEPARTMENT OF MECHANICAL ENGINEERING

Master of Technology in 'Mechanical Engineering'- (2021-22)

Category	Core	OE	Seminar	Project	Total
Credits	30	06	02	19	57

Programme Core (PC)

S. No.	Course Code	Title	L-T-P	Credits
1	MEL 510	Introduction to FEM	2-1-0	3
2	MEL 530	Advanced Manufacturing Processes	2-1-0	3
3	MEL 550	Advanced Heat & Mass Transfer	2-1-0	3
4	MEL 560	Advanced Machine Design	2-1-0	3
5	MEL 570	Production and Operations Management	2-1-0	3
6	MEL 580	Advanced Fluid Dynamics	2-0-2	3
7	MEL 613-IP	Project Management	2-1-0	3
8	MAL 616	Research Methodology	2-1-0	3
9	MEL614	Technical Writing Skills	2-0-0	2
10	MEP601	Laboratory Training-I	0-0-4	2
11	MEP602	Laboratory Training-II	0-0-4	2
		Total Credits		30

Master of Technology in 'Mechanical Engineering'- (2021-22)

Semester	Semester Course Code, Course Name (L-T-P) Credits				Lecture	L	T	P	Contact Hour per week	Credits
1	**MEL-510** Introduction to FEM (2-1-0) 3	**MEL-613-IP** Project Management (2-1-0) 3	**MEL-580** Advanced Fluid Dynamics (2-0-2) 3	**MEP601** Laboratory Training, I 0-0-4 (2)	3	6	2	6	14	11
2	**MEL-550** Advanced Heat and Mass Transfer (2-1-0) 3	**MEL-560** Advanced Machine Design (2-1-0) 3	**MEL-530** Advanced Manufacturing Processes (2-1-0) 3	**MEP602** Laboratory Training, II 0-0-4 (2)	3	6	3	4	13	11
3	**MEL-570** Production and Operation Management (2-1-0) 3	**MEC-620** Seminar (Specialization based) 0-0-4 (2) Credits	*Open Elective-1 (2-1-0) 3 Credits		2	4	2	4	10	8
4	**MAL616**	**MED 612** Minor Project	**MEL614** Technical		2	4	1	6	11	8

#										
	Research Methodology (2-1-0) 3	(Specialization based) 0-0-6 (3)	Writing Skills 2-0-0 (2)							
5	*Open Elective-2 (2-1-0) 3 Credits	**MED-600** Project Part -1 (Specialization based) (00-12) 6 Credits			1	2	1	12	15	9
6	**MED-610** Project Part -2 (Specialization based) (0-0-20) 10 credits				0	0	0	20	12	10
					Total Credits=					**57**

*Open electives can be chosen from the list of Open Elective courses offered by the University. These may be run as Regular or MOOC (full/blended).

B.Tech in Mechanical Engineering with specialisation in Robotics and Automation (2021-22)

Category	Credits	Category	Credits
BS	21 Core	SPT	18
HMS	14 Core + 03 Elective	Special Software (VA)	3
ES & TA	30 Core	PE	18
PC	44 Core	OE	12
Community Service	6	GP	6

TOTAL CORE COURSE CREDITS = 112 **TOTAL CREDITS = 175**

Basic Sciences (BS) Core		L-T-P	C	Programme Core (PC)		L-T-P	C
CHL150	Engineering Chemistry	2-0-2	3	MEL 160	Production Engineering	3-0-2	4
CHL100	Environmental Studies	3-0-0	3	MEL203	Mechanics of Solids – I	3-0-2	4
MAL151	Engineering Maths-I	3-0-2	4	MEL202	Heat & Mass Transfer	3-0-2	4
MAL152	Engineering Maths-II	3-0-2	4	MEL206	Theory of Machines	3-1-2	5
MEL 209	Materials Science and Engineering	2-0-2	3	MEL 207	Machine Design – I	3-1-0	4
PYL150	Engineering Physics	3-0-2	4	MEL208	Fluid Mechanics	3-1-0	4
	Total BS Core		**21**	MEL 310	Industrial Engineering	3-1-0	4
Humanities & Management Sciences (HMS) Core		**L-T-P**	**C**	MEL 314	Energy Conversion	3-0-2	4
CLL101	Effective Communication-I	2-0-1	2.5	MEL 326	Instrumentation & Control Engineering	3-0-2	4
CLL102	Effective Communication-II	2-0-1	2.5	MEL 303	Fluid Machines	2-1-2	4
CLL120	Human Values and professional Ethics	2-0-0	2	MEL 401	Operations Research	2-1-0	3
SML200	Engineering Economics	2-0-2	3	**Total Programme Core (PC)**			**44**
CLP300	Campus to Corporate	1-0-0	1				
SML300	Entrepreneurship	3-0-0	3				
	Foreign Language Elective	3-0-0	3				
Total HMS Core			**16**	**Seminar/Projects/Trainings (SPT)**		**L-T-P**	**C**
				MEC 321	Seminar	--	1
Engineering Sciences & Technical Arts (ES & TA) Core		**L-T-P**	**C**	MED 210	Minor Project	-	2
CSL106	FOCP-I	2-0-4	4	MED 423	Major Project 1	-	4
CSL108	FOCP-II	2-0-4	4	MED 424	Major Project 2	-	6
CSL 110	Problem Solving and Design Thinking	2-0-2	3	MET310	Industrial Training-I	-	2
ECL110	Basics of Elect. & Electronics Engg	2-0-2	3	MET410	Industrial Training II	-	3
MEP110	Engineering Graphics & Drawing	1-0-4	3				
MEL150	Basics of Mechanical and Civil Engineering	2-0-2	3	**Total SPT Credits**			**18**
MEL205	Engineering Mechanics	3-1-0	4	**Value Added and others**		**L-T-P**	**C**
MEP 207	Machine Drawing	0-0-4	2	MEP200 MEP220 MEP300	Special Software: Solid Works/ ANSYS/ MATLAB/other software packages (0-0-2) 1	0-0-2 0-0-2 0-0-2	1 x 3 = 3
MEL290	Thermodynamics	3-1-0	4		**General Proficiency**	**(1x6)**	**6**
	Total ES & TA		**30**		Open Electives (OE). Four courses of 3 credits each	(4 x 3)	12

		Programme Electives (PE). Six courses of 3 credits each	(3 x 6)	18
		Community Service	---	6
SEG400		Self-Study Course GATE		NC

B. Tech in Mechanical Engineering with specialization in Robotics and Automation (2021-22)

Semester	Semester Course Code, Course Name (L-T-P) Credits							GP	Community Service	Hrs. Per week			Contact Hours per Semester	Credits
										L	T	P		
1	MAL151 Engineering Maths-I (3-0-2) 4	CSL106 FOCP-I (2-0-4) 4	CHL150 Engineering Chemistry (2-0-2) 3	CLL101 Effective Communication-I (2-0-1) 2.5	MEP110 Engineering Graphics & Drawing (1-0-4) 3	CSL110 Problem Solving and Design Thinking (2-0-2) 3		MER118 GP 1 Credit	MES101 CS-I (70 Hours) NC	12	1	14	405	20.5
2	MAL152 Engg Maths-II (3-0-2) 4	CSL108 FOCP-II (2-0-4) 4	PHY150 Engineering Physics (3-0-2) 4	CLL102 Effective Communication-II (2-0-1) 2.5	MEL150 Basic of Mechanical and Civil Engineering (2-0-2) 3	ECL110 Basic of Electrical & Electronics Engineering (2-0-2) 3		MER119 GP 1 Credit	MES102 CS-II (70 Hours) 2 Credits	14	1	12	405	21.5+2
	MED 210: Minor Project + Community Service (Remaining Hours)													02
3	MEL215 Production Engineering (3-0-2) 4	MEL203 Mechanics of Solids-I (3-0-2) 4	MEL290 Thermodynamics (3-1-0) 4	MEL205 Engineering Mechanics (3-1-0) 4	MEP207 M/c Drawing (0-0-4) 2	Open Elective-1 (3-0-0) 3	MEP200 Special Software Solidworks/ANSYS/ MATLAB/other software packages (0-0-2) 1	MER218 GP 1 Credit	MES201 CS-III (35 Hours) NC	15	2	10	405	23
4	MEL 314 Energy Conversion (3-0-2) 4	MEL206 Theory of Machines (3-1-2) 5	MEL208 Fluid Mechanics (3-1-0) 4	MEL209 Materials Science and Engg. (2-0-2) 3	Open Elective-2 (3-0-0) 3	CLL120 Human Values and Professional Ethics (2-0-0) 2	MEP220 Special Software Solidworks/ANSYS/ MATLAB/other software packages (0-0-2) 1	MER219 GP 1 Credit	MES202 CS-IV (35 Hours) 1 Credit	16	2	8	390	23+1

#											L	T	P		Credits
	MET 310: Industrial Training I + Community Service (70 Hrs)														02
5	**MEL202** Heat and Mass Transfer (3-0-2) 4	**MEL207** Machine Design I (3-1-0) 4	**MEL303** Fluid Machines (2-1-2) 4	**SML300** Entrepreneurship (3-0-0)3	PE-1 (2-0-2) 3	**SML200** Engineering Economics (2-0-2) 3		**MEP300** Special Software Solidworks /ANSYS/ MATLAB/other software packages (0-0-2) 1	**MER318** GP 1 Credit	**MES301** CS-V (35 Hours) NC	15	2	10	405	23
6	**MEL 326** Instrumentation & Control Engineering (3-0-2) 4	**MEL 310** Industrial Engineering (3-1-0) 4	PE-2 (2-0-2) 3	PE-3 (2-0-2) 3	Open Elective-3** (MOOC/45) (3-0-0) 3	Foreign Language Elective (3-0-0) 3	**CLP300** Campus to Corporate (1-0-0) 1		**MER319** GP 1 Credit	**MES302** CS-VI (35 Hours) 1 Credit	17	1	6	360	22+1
	MET 410: Industrial Training-II + Community Service(70 Hrs)														03
7	**MEL401** Operations Research (2-1-0) 3	PE-4 (2-0-2) 3	PE-5 (2-0-2) 3	**CHL100** Environmental Studies (3-0-0) 3	**MED423** Major Project I 4 Credits		**MEC321** Seminar 1 Credit			**MES401** CS-VII (70 Hours) NC	9	1	8	270	17
8	**MED424** Major Project II /Internship 6 Credits	PE-6 (2-0-2) 3	Open Elective-4** (MOOC/45) (3-0-0) 3				**SEG 400** Self study Gate Non Credit			**MES402** CS-VIII (70 Hours) 2 Credit	6	-	6	180	12+2
	Total										109	10	62		169+6 =175

Program Electives for the specialization- Robotics and Automation

Tracks	Robotics and Automation
Program Elective-1	MEL-478 Robotics and Control (2-0-2) 3
Program Elective-2	MEL-479 Industrial Automation and Process Control (3-0-0) 3
Program Elective-3	MEL-480 Mechatronics System Design (2-0-2) 3
Program Elective-4	MEL-481 Advanced Robotics (2-1-0) 3
Program Elective-5	MEL-486 Signal Processing, AI & NN Technique (2-0-2) 3
Program Elective-6	MEL-677-IP Optimization Techniques (2-0-2) 3

Course Descriptions:

M.TECH. (Mechanical Engineering)

MEL 510 (2-1-0) 3 – Introduction to FEM
Linear algebra: matrix operations, numerical solution of linear matrix equations; Elasticity theory: strain-displacement and stress-strain relations, temperature effects, St. Venant's principle; Discretization (1-D and 2-D), Stiffness matrix, FEM equation for simple elements (bar, truss, beam, frame, and CST elements), assembling of elements, boundary conditions, nodal solutions; Coordinate systems, Shape functions, Consistant loads, Variational equation for deriving K; Heat conduction equations, FEM formulation in 2-D conduction problems; Practical points in using FEM software (Types of analysis, Meshing, Post-processing, Non-linear analysis)
Tutorial (T): Numericals on various topics; Modeling and simulation of 1-D and 2-D problems using software: static structural analysis, and heat conduction; Presentations by students about their course mini-projects

MEL 530 (2-1-0) 3 – Advanced Manufacturing processes
Advanced Machining Processes- Introduction, Process principle, Material removal mechanism, Parametric analysis and applications of processes such as ultrasonic machining (USM), Abrasive jet machining (AJM), Water jet machining (WJM), Abrasive water jet machining (AWJM), Electrochemical machining (ECM), Electro discharge machining (EDM), Chemical Machining(CHM), Electron beam machining (EBM), Laser beam machining (LBM) processes; Advanced Casting Processes- Squeeze casting, Vacuum mould casting, Evaporative pattern casting, Ceramic shell casting; Advanced Welding Processes- LBW, EBW; Advanced Metal Forming- - Details of high energy rate forming (HERF) process, Electro-magnetic forming, explosive forming, Electro-hydraulic forming, Stretch forming, Contour roll forming; Rapid Prototyping and Rapid tooling- principle of Rapid Prototyping (RP) and Rapid tooling, comparison with conventional machining processes, various techniques for RP

MEL 613 IP (2-1-0) 3 Project Management
Introduction to Project management: The growing importance/d relevance in the current environment. Project vs. Ongoing Operations, project characteristics, common terms used in project, growing importance, steps & check points, phases in the project cycle, Project Types: Pure Project, Functional Project and Cross-Functional or matrix structure. People aspect: Project leader, Roles, responsibilities, authority, accountability, team structure, stake holders. Project appraisal: Project Budgeting, Investment Planning, Pay back periods, ROI, IRR, NPV, project selection decisions Project Risk Management: Risk identification, its assessment, Mitigation plan and case study. Project Network techniques: Work Breakdown Structure, Project Control Charts, GANTT charts, Network Planning Models; AOA & AON approach, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Floats, Network understanding, drawing and the analysis. Project Software: Primavera software and its application. Project Crashing & Leveling: Time-Cost Trade-off, Crashing, Resource loading and Leveling. Project control and evaluation: Project Control and Evaluation Mechanisms, Project Time and Cost Overruns, Schedule / cost / Time / Resource variation over time. Interaction with an experienced project expert from industry: Sharing of the practical do's/ don'ts and other learnings. Project ethics and contractor management. Project failure prevention: Causes of Project success & Failure, failure preventive measures, Case Studies Relating to Successful and Unsuccessful projects.

MEL 550 (2-1-0) 3 – Advanced Heat and Mass Transfer
Recapitulation of laws governing heat & mass transfer; General conduction equation - in rectangular cylindrical and spherical coordinates; Unsteady state conduction- large plane walls, cylinder and spheres; Heat transfer from extended surfaces- proper length of a fin; Multidimensional conduction; Numerical solution of conduction problems; Thermal radiation gray body radiation, radiation shields; Natural and forced convection; Heat exchangers-

effectiveness-NTU; Phase Change heat transfer- flow boiling and film condensation; Special topics in heat transfer.

Tutorial (T): Experiments will be carried out in lab on different test setups; numerical on heat transfer problems.

MEL 560 (2-1-0) 3 – Advanced Machine Design
Design methodology (Phases of a design project, Need identification and problem formulation, Designing to codes and standards); Failure theories (static failure theories, fatigue failure, fracture mechanics); Stress analysis and design of machine elements under conditions of impact, inertial forces, thermal, and residual stresses; Surface Failure (Surface geometry, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue, Spherical contact, Cylindrical contact); Reliability engineering (Distribution models, Probabilistic approach to design, Definition of reliability, Constant and variable failure rates, System reliability, Maintenance and repair, Design for reliability, FMEA, Fault tree analysis).
Tutorial (T): Presentations and case studies by students related to the course content; Presentations and case studies by students related to their mini projects; case studies; solving problems related to the syllabus.

MEL 570 (2-1-0) 3 – Production and Operations Management
Production and Operations function- Production systems, Product Strategy and integrated product development, Process planning, Capacity Planning, Facilities Location Strategies, Methods study and Work Measurement, Line balancing, Group Technology, Cellular Manufacturing, Flexible manufacturing system, Aggregate production planning, Master Production Scheduling, Shop Scheduling and Shop Floor Control; Inventory control- JIT purchasing, Lead-time control; Maintenance Planning and Management- Corrective, Preventive and Predictive maintenance; Manpower Scheduling- Techniques of manpower scheduling, Service Operations Management. Value flow and application of VSM. QFD.

MEL 580 (2-0-2) 3 – Advanced Fluid Dynamics
Recapitulation of basic laws of fluid flow in integral and differential form. Newtonian fluid flow- Governing Equations for incompressible non-viscous & viscous internal and external flows. Fundamental of compressible and unsteady flows. Introduction to Computational Fluid Dynamics.
Tutorial (T): Numerical, problem solving on CFD software and presentations.

MAL 616 Research Methodology
3 credits (2-1-0)
Foundations of Research, Scientific Research, Motivation, Research Objectives, Research Designs, Research Processes, Understanding Feasibility of Objectives and Processes, Qualitative and Quantitative Research Methods, Data Collection Processes, Biases in Data Collection, Data Pre-processing, Sampling Distribution and Confidence Intervals, Hypothesis Testing, Interpretation of Results, Literature Review, Technical Writing, Citations, Reference management software, Plagiarism, Software for Detection of Plagiarism.

MEC-620: Seminar
(2 Credits)
Every student will be required to present a seminar on a topic approved by the department except on his/her Major Project . The committee constituted by the Head of the Department will evaluate the presentation and will award one of the grades on the basis of "NCU Course credit Regulation-Engineering.

MEL514 Technical Writing skills
 2 (2-0-0) credits

Types of technical writing, definition writing and analysis of material, description of mechanisms and processes, library resources, research techniques, and proposal writing, collecting notes, writing outlines, and writing rough drafts, the elements of the formal research report, graphic aids in technical reports, grammar, technical writing style, and paper revision, plagiarism and professional ethics.

MED512 Minor project
(Specialization based) 0-0-6 (3)
The minor project will be a design project (hardware/software) on a topic suggested by the course coordinator to be completed during the designated duration. It may be of practical and theoretical interest. It has to be done under the guidance of a faculty and students are expected to complete literature survey, feasibility testing, develop or implement the research work.

MEP501 Laboratory Training I
2 Credits (0-0-4)
This is a lab/practical course and the lab experiments of core courses running in that semester will be conducted under this laboratory training.

MEP502 Laboratory Training II
2 Credits (0-0-4)
This is a lab/practical course and the lab experiments of core courses running in that semester will be conducted under this laboratory training.

MED-600: Major Project Part -1
(6 Credits)
Every student will carry out Major Project under the supervision of supervisor(s). The topic will be approved by the committee formed by the Head of Department. The Major Project work should involve extensive literature survey, design, development, analysis and computer simulation (if applicable), fabrication and experimentation work. The project report is expected to show clarity of thought and expression and analytical or experimental or design skills. Every student will be required to present two Major Project seminar talks. First at the beginning of the Major Project to present the scope of the work and to finalize the topic, and the second towards the end of the semester, presenting the work carried out by him/her in the semester. The committee constituted by the Head of the Department will screen both the presentations so as to award grades. The grading shall be done on the basis of "NCU Course credit Regulation-Engineering."

MED-610: Major Project Part -2
(10 Credits)
The Major Project Part -I (MED-600) will be continued as Major Project part - II in 4th semester. Major Project will be evaluated and grades will be awarded by the committee of examiners formulated by the Head of the department based on the "NCU Course credit Regulation-Engineering." As in Major Project part -I.

Syllabus: B.TECH. (Mechanical Engineering)

MEP 110 (1-0-4) 3 – Engineering Graphics and Drawing

Types and use of lines and lettering; dimensioning; first and third angle systems of orthographic projection; projection of points in different quadrants; projection of lines; projection of planes; projections of solids; development of surfaces; section of solids (section planes, sectional views, true shape of sections); isometric projections; intersection of solids.

Practice(P): Tutorial sheets to be completed during practical classes.

MEL 150 (2-0-2) 3 Basics of Mechanical and Civil Engineering

Brief Syllabus: Introduction to Thermodynamics: Thermodynamics Laws and applications; Concepts of state, work and heat, internal energy, enthalpy and entropy. Boilers: construction, classification and application. I.C engines: two-stroke and four-stroke petrol and diesel engines; MPFI technology. Advances in automobile technologies. Simple lifting Machine. Power Transmission. Stress and strain. Applied Mechanics: Force System, Laws of Mechanics and Introduction of Moment of Inertia. Engineering materials: classification, properties & applications. Introduction to Conventional and Unconventional Manufacturing processes; Plant layout. Introduction to Mechatronics and Robotics. Introduction to Engineering Surveying and Smart Infrastructure.

Tutorials: Numericals based on thermodynamics, stress-staring, applied mechanics, lifting machines, and Surveying.

Practicals: Experiments of lifting machines. Study of engine and boiler models. Making jobs in welding shop, Machining Shop, Foundry Shop and Carpentry Shop. Field Exercises of surveying.

MEL 160 (3-0-2) 4 Production Engineering

Casting – Introduction and classification, design of patterns patterns, moulds and cores, solidification and cooling, riser and gating design. Plastic deformation and yield criteria, fundamentals of hot and cold working processes, load estimation for bulk metal forming processes (forging, rolling, extrusion, drawing), load estimation for sheet metal forming processes(shearing, deep drawing, bending). Principles of powder metallurgy (metal and ceramic powders), product types and characteristics. Principles of welding, brazing, soldering and adhesive bonding. Raw material manufacturing. Surface treatment processes. Metal Cutting (Introduction, system of tool nomenclature, tool geometry and materials, mechanics of chip formation, Introduction to single & multipoint cutting tool). Economics of machining. Analysis of machining (forces in orthogonal cutting, merchant's force circle diagram, temperature distribution at tool chip interface, wear of cutting tools, optimum tool life, tool life equations, machinability, surface roughness). Introduction to Machining processes.

Use of coolant in machining. Principles of work holding, design of jigs and fixtures. Metrology (introduction to metrology, types of inspection, limits, fits & tolerance, tolerance analysis in manufacturing and assembly). Measuring Instruments (Linear and angular measurement), form measurement (Roundness & Flatness). Surface finish measurement.

Practice(P): Practice in workshop (job making) based on above topics.

MEL203 (3-0-2) 4 - Mechanics of Solids – I

Concept of stress and strain, Hooke's law, elastic constants, Poisson's ratio, Principle of superposition, One and two-dimensional stress problems, Thermal stresses and strains, Complex stresses and strains, Principal stresses, 2D & 3D Mohr's circle of stress and strain. Shear force and bending moment diagrams for beams. Bending and shearing stresses in beams, Deflection of beams. Torsion of circular sections and thin walled tubes. Concept of strain energy, Strain energy due to axial loading, pure shear, bending, and twisting. Stresses due to gradually applied load, suddenly applied load, impact or shock load.

Practice(P):

- Tensile Test, Compression Test, Bending Test, Shear Test, Torsion Test, Impact Test, Hardness test, Cupping Test and numerical practice on related topics.
- Virtual tests from Virtual Labs (http://vlab.co.in/)
- Case study on Stress analysis of simple structural elements using FEM software

MEL 290 (3-1-0) 4 – Thermodynamics

Basic Concepts: Thermodynamic systems and processes, ideal gas, calculation of heat and work in various processes. Laws: Zeroth Law, 1st law of thermodynamics for closed and open systems, concept of internal energy and enthalpy, 2nd law of thermodynamics-corollaries, Clausius inequality, entropy, statement of 3rd law of thermodynamics. Availability Concepts: Availability, irreversibility and Application of 2nd Law Efficiency. Pure substance and its properties. Properties of steam, property chart, and steam table. Joule-Kelvin Effect. Clausius-Clapeyron Equation. Thermodynamic relations. Behaviour of real gas.

Turorial (T): Numericals based on above topics.

MEL205 (3-1-0) 4-Engineering Mechanics

Introduction: idealization of mechanics, force system, moment of force system, laws of mechanics. Equilibrium: free body diagrams, equilibrium equations. Structures: Simple trusses, frames and analysis of structures. Moment of inertia: types, principal axes theorem, parallel axes theorem, product of inertia, Principle of virtual work,

methods of minimum potential energy, stability. Kinematics of particles and rigid bodies in plane motion, Kinetics of particles and rigid bodies: Particle dynamics, Newton's laws for plane motion, D 'Alembert's principle (Dynamic equilibrium), Impulse and momentum, Work energy equations, Impact, Collision of particles. Friction force, laws of sliding and rolling friction, equilibrium analysis of simple systems with sliding friction.

Tutorial (T): Numerical Problems on force system, equilibrium, kinematics and kinetics; Case studies on identification of force system, kinematics of rigid body; Presentations on given topics and mini projects (if possible).

MEP 207 (0-0-4) 2 – Machine Drawing

Sectional views: full and half section views, standard practices; Tolerance: coordinate tolerancing, geometric tolerancing, gauging and measuring principles, material conditions, tolerance symbols; Assembly drawing: types of assembly drawing, sectioning, dimensioning, and hidden lines in assembled views, standard parts in assembled views; Computerized 2-D drawing using AutoCAD: draw toolbar; modify toolbar; dimensioning toolbar; properties toolbar; ortho and OSnap; layers.

Practice(P): Exercises on the above topics should be done with common machine components such as: threaded joints (threaded fasteners, locking arrangements); keys, cotter and knuckle joints; couplings (flange, muff, and Oldham's couplings). Minimum 4 manual drawing sheets and 4 CAD sheets must be made by the students during the course. AutoCAD drawing should be taught from the beginning of the course.

MEL 314 (2-0-2) 3- Energy Conversion

Energy Sources, Fuels and Combustion: Types of fuels, Combustion equations, Stoichiometric air fuel ratio, orsat analyser, Determination of calorific value of fuels; Fundamentals of Steam power: Rankine cycle, Reheat & Regeneration, Binary Vapour cycles, steam turbines and nozzles; Thermal power plant: Boilers, Low pressure and High pressure, boilers mountings and accessories, Compounding of Turbine, , Cooling Towers; Gas power cycles: Air standard Otto Cycle, Diesel Cycle, Dual Cycle, Brayton cycle, Stirling cycle and Ericsson cycle; Gas Turbines: Gas turbine cycles, operation and materials; Condensers; Gas compressors; Refrigeration and air conditioning: Refrigeration cycles, refrigerants, psychometry.

Practice(P): Numerical on energy conversion and power point presentation by students. Experiments in the energy conversion lab.

MEL206 (3-1-2) 5- Theory of Machines

Introduction: Kinematic Links, Kinematic Pairs, Kinematic Chains, Planar Mechanisms, Degree of Freedom, Inversions of Planar Mechanisms. Kinematics: Displacement, Velocity and Acceleration analysis of planar mechanisms. Dynamics: Static and Dynamic Force Analysis of Planar Mechanisms, Flywheel, Balancing of Rotating and Reciprocating Masses. Classification of Gears, Gear Terminology, Law of Gearing, Velocity of sliding, Gear Teeth Profile, Path of Contact, Arc of Contact, Contact Ratio, Interference of in Involute Gears, Minimum Number of Teeth, Undercutting, Gear Forces, Different Types of Gear Trains, Analysis of Epicyclic Gear Train, Types of Cams and Followers, Cam Terminology, Derivatives of Follower Motion, Cam Profile Layout, working of Governors and Gyroscope.

Tutorial: Numerical on velocity analysis, acceleration analysis, static and dynamic force analysis, balancing of rotating and reciprocating masses, balancing of different configuration of engines, Projects to design mechanisms.

Practical: Experiments on linkages & mechanisms, Governers, balancing and Gyroscope..

MEL208 (3-1-0) 4-: Fluid Mechanics

Fluid Properties - Concept of fluid-flow, ideal and real fluids, properties of fluids, Newtonian and non-Newtonian fluids; Fluid Statics - Pascal's law, hydrostatic forces on bodies, stability of floating and submerged bodies; Fluid Kinematics - Eulerian and Lagrangian description of fluid flow; fluid acceleration, stream, streak and path lines, types of flows, continuity equation, rotation, vorticity and circulation, stream and potential functions; Fluid Dynamics - Concept of system and control volume, Euler's equation, Bernoulli's equation, correction factors, Impulse momentum relationship and its applications; Laminar Flow - Flow regimes and Reynolds number, analysis of uni-directional flow between parallel plates; Flow through Pipes - Losses in pipes, Hagen-Poiseuilli law, hydraulic gradient and total energy lines, series and parallel connection of pipes, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes. Boundary Layer Flow (External Flows)- Concept, displacement, momentum and energy thickness, Von-Karman momentum integral equation, laminar and turbulent boundary layer flows, boundary layer separation and control, concept of drag and lift.

Tutorial (T): Numericals based on above topics.

MEL-209(2-0-2) 3- Materials Science and Engineering

Introduction to Materials Science- Type of materials, Atomic Structure, Interatomic Bonding and Structure of Crystalline Solids, Crystal imperfections; Metallographic techniques of sample preparation; Mechanical Properties of metals- elastic and plastic

deformations; Thermo-mechanical processing of metals and alloys; Phase diagrams; Heat treatment processes; Failure in materials-Ductile & Brittle Fracture and Fatigue, Creep and stress rupture, stress strain diagrams for engineering materials; Types of materials systems-Metallic alloys, Ceramics, Polymeric and Composite materials, magnetic and diamagnetic materials; Corrosion- electrochemistry, types of corrosion; Oxidation; Characterization of materials- x-ray diffraction and scanning electron microscopy.

Practice(P): Presenting demo model for crystal structures and imperfections in crystals, Metallographic techniques for sample preparation; microstructure observations of deformed and corroded samples under electron microscope; characterization and analysis of deformed specimens under both metallographic and electron microscopes. Impact Testing after Heat Treatment with different cooling media.

MEL 202 (3-0-2) 4- Heat & Mass transfer

Modes and Basic laws of Heat & Mass transfer; General conduction equations in Cartesian, Cylindrical and Spherical coordinates; Steady state one dimensional heat conduction with and without heat generation, Electrical analogy, Critical thickness of insulation, Fins; Unsteady heat conduction, lumped analysis, Heisler's charts; Governing equations for Convective heat transfer, Thermal boundary layer; Forced convection, Free convection; dimensionless parameters in free and forced convective heat transfer; Heat transfer correlations for flow over flat plates and through pipes, effect fo turbulence; Boiling and condensation; Heat exchangers, LMTD and NTU methods; Radiative heat transfer, Stefan-Bolzmann law, Wien's displacement law, black and gray surfaces, view factor; Radiation network analysis; Radiation shields; Heat and mass transfer analogy; Mass diffusion equation.

Practice (P): Experiments will be carried out in lab on different test setups; Numerical on heat transfer problems.

MEL207 (3-1-0) 4 - Machine Design I

Factors to be considered in design projects; phases of a design project; mission and requirements documents; design engineer's professional responsibilities; introduction to CAE; design for static and dynamic loading; factor of safety; theories of static failure (Tresca, von Mises, modified Mohr); stress concentration; basics of statistics (Frequency distribution; measures of central tendency and dispersion; normal distribution); fatigue failure (fatigue test, S-N curve, Goodman's line); design of shafts and keys (design based on strength, design based on deformation, design of keys); rolling and sliding contact bearings (types of rolling contact bearings, selection of deep groove ball bearings, reliability and life of bearings); design of belt drive systems (types of belts, design of flat and V belt systems); design of welded joints (types of weld, weld symbols, Butt and fillet weld calculations, welded joints under torsion and bending, weld inspection); Design of riveted joints; Manufacturing considerations in design (casting, forging, machining, cold working, welding, DFMA)

Tutorial (T): Brain storming and class activities related to determination of design requirements; solving numericals related to the course content; presentations by students about their projects

MEL303 (2-1-2) 4 Fluid Machines

Impact of free jets: Impulse – momentum principle, jet impingement on various stationary and moving geometries, jet propulsion of ships. Hydraulic Turbines: Classification, Impulse & reaction principles, component parts, construction, operation, governing mechanism, design aspects, velocity diagrams and performance characteristics of a Pelton wheel, Francis and Kaplan turbine, slow, medium and fast runners, degree of reaction, unit quantities, specific speed and model relationships for turbines, scale effect, cavitations. Centrifugal Pumps: Classification, construction, operation, design aspects and performance characteristics, minimum starting speed, multi-stage pumps. Similarity relations, specific speed, net positive suction head, cavitation and maximum suction lift. Reciprocating Pumps: Construction and operational details, effect of acceleration and friction on indicator diagram (pressure – stroke length plot), separation, air vessels and their utility, rate of flow into or from the air vessel, maximum speed of the rotating crank, characteristic curves. Hydraulic systems: Function, construction and operation of Hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic lift and hydraulic press, Fluid coupling and torque converter, Hydraulic ram. Dimensional Analysis.

Tutorial (T) and Practical (P): Numerical solving and conduct of experiments.

MEL326 (3-0-2)4- Instrumentation and Control Engineering

Introduction of Instruments and their types, standards and their calibration, strain gauges and rosettes, static and dynamics characteristics of instruments, , first and second order systems: transient and frequency response, error and uncertainties in performance parameters, transducers, digital logic number system, signal conditioners, Data acquisition system, introduction to control systems, types of control systems, transfer function of the systems, sequence control, stability check using Routh, root locus, Bode and Nyquist method, Fundamentals of vibration, free, damped and forced vibrations for single DOF system, vibration isolation, critical speeds of shafts.

Practice (P): Questions on classification of different types of instruments, numerical on static and dynamic characteristics based upon order of systems, descriptive questions on transducers and signal conditioners with numerical, questions on stability criterion, Practical measurement of displacement, load etc.; Data acquisition;

Experimental study of 1st and 2nd order systems; Stability analysis using Matlab; experiments on different control systems, PID Controller

MEL310 (3-1-0) 4- Industrial Engineering

Introduction to the need of IE and industrial safety, Productivity and productivity measurement; Work Study- Method Study and Work measurement, Job evaluation, wage incentives; Plant Location and Layout- Plant Location, Plant Layout; Material Handling and ergonomics, Production systems and their characteristics, systems analysis, Sequencing and scheduling; Inventory Management- Forecasting models, Inventory Control, Determinisic models and applications, safety stock inventory control systems; Aggregate production planning; Quality Management- Basic concepts in quality, cost reduction, 7 QC tools, Control charts and Process capability, Six Sigma and TPS; Materials requirement planning; Value Engineering- Value engineering, waste management; Selected topics- Introduction to Lean Systems, Value Stream Mapping, SMED, Total Productive Maintenance, the big losses and OEE.

Tutorial (T): To carry out case study on productivity measurement, Method study, Time study, Plant Location, Plant Layout, select material handling system for particular product, Problems related to inventory management, Value engineering, Value stream mapping.

MEL401 (2-1-0) 3- Operations Research

Role of operations research in decision making, applications in industry; concepts in OR model building; Linear programming: Graphical method and Simplex methods, BIG-M and Two phase methods; computational problems; Allocation models: Transportation and Assignment problems; Advanced topics of linear programming: Duality, Primal-Dual relations, sensitivity analysis, dual simplex method; Simulation models, Monte Carlo technique and its applications, Queuing models and its applications; Software tools for Operations Research

Tutorial (T): Numericals Based on above topics. Case Studies

MEL-677-IP (2-0-2) 3-: Optimization Techniques

Introduction and Basic Concepts:- Historical Development; Engineering applications of Optimization; Art of Modeling, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems; Classification of optimization problems; Optimization techniques; Functions of single and two variables; Global Optimum; Convexity and concavity of functions of one and two variables; Optimization of function of one variable and multiple variables; Gradient vectors; Optimization of function of multiple variables subject to equality constraints; Lagrangian function; Optimization of function of multiple variables subject to equality

constraints; Hessian matrix formulation; Eigen values; Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations; Graphical method for two variable optimization problem; Examples; Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems; Revised simplex method; Duality in LP; Primal dual relations; Dual Simplex; Use of software for solving linear optimization problems using graphical and simplex methods; Examples for transportation, structural and other optimization problems; Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality; Problem formulation and application in Design of continuous beam and Optimal geometric layout of a truss; Water allocation as a sequential process; Capacity expansion and Reservoir operation; Integer linear programming; Concept of cutting plane method; Mixed integer programming; Solution algorithms; Examples; Piecewise linear approximation of a nonlinear function; Multi objective optimization – Weighted and constrained methods; Multi level optimization; Direct and indirect search methods; Evolutionary algorithms for optimization and search; Applications in Robotics

List of experiments: 1 Matrix operations in Matlab 2 Differentiation of a vector and matrix in Matlab 3 Integration of a vector and matrix in Matlab 4 Simplex algorithm in Matlab 5 Implementation of Newton's method in Matlab 6 Implementation of Secant method in Matlab 7 Implementation of Lagrange multiplier method in Matlab 8 Implementation of KKT theorem in Matlab 9 Implementation of BFGS method in Matlab

MEL-478 (2-1-0) 3-: Robotics and Control

Introduction to robotics: Evolution of Robots and Robotics, Progressive advancement in Robots, Robot component , Robot Anatomy, Robot Degree of Freedom, Robot Joints, Robot Co-ordinates, Robot Reference frames, Programing Modes, Robot characteristics, Robot Workspace, Robot Applications. Kinematics of robots- Position analysis: Robot as Mechanism, Conventions, Matrix representation, Homogeneous Transformation, Representation of transformation, Inverse of Transformation, Forward and Inverse Kinematic of Robots, Forward and Inverse kinematics equations: position and orientation, Roll, Pitch ,Yaw Angles, Euler Angles, Articulated Joints, Denavit Hartenberg Representation of forward kinematics, Inverse Kinematic Programming of Robot, Degeneracy and Dexterity , Differential motions and velocities: Differential relationship, Jacobian, Differential versus large scale motions, Differential motions of a frame versus a Robot, Differential motion of a frame about Reference axes, General axis, Frame, Interpretation of the differential change, Differential Change between frames, Simple manipulators: Two /three arm manipulators and their kinematics equations, Work space Homogeneous Transformation: Rotation, Translation, Composition of homogeneous transformations.

MEL-479 (3-0-0) 3-: Industrial Automation and Process Control

Production systems Categories of manufacturing systems, manufacturing support systems, automation in production systems, automated manufacturing systems, opportunities for automation and computerization, types of automation, computerized manufacturing support systems, reasons for automating, automation principles and strategies, the USA principle, ten strategies for automation, automation migration strategy ,Automation and control technologies in production system Basic elements of an automated system, advanced automation functions, levels of automation, continuous and discrete control systems, computer process control, common measuring devices used in automation, desirable features for selection of measuring devices ,Material handling system Material handling equipment, design considerations for material handling system, material transport equipment, analysis of material transport systems, storage systems and their performance and location strategies, conventional and automated storage systems, overview of automatic identification and data capture, bar code technology, RFID, other AIDC technologies ,Production and assembly systems Automated production lines- fundamentals, system configurations, work part transfer mechanisms, storage buffers, control of production line, applications Automated assembly systems- fundamentals, system configurations, parts delivery at work stations, applications ,Cellular manufacturing Group technology, part families, parts classification and coding, production flow analysis, Opitz coding system, composite part concept, machine cell design, applications of GT ,Flexible manufacturing systems Introduction to FMS, types of FMS, FMS components, applications and benefits, planning and implementation issues in FMS, quantitative analysis of FMS.

MEL-480 (2-0-2) 3-: Mechatronics System Design

Introduction to Mechatronics, Integrated design issues in mechatronics, The mechatronics design process, Mechatronics Key elements, Application in mechatronics.Operator notation and transfer functions, block diagram , manipulations , and simulation, Block diagram modeling direct method and analogy method, electrical system, mechanical translational systems, Mechanical Rotational system, electrical mechanical coupling, fluid system Introduction to sensors and transducers, sensitivity Analysis sensors for motion and position measurement, force , torque and tactile sensors, vibration-acceleration sensors, sensors flow measurement , temperature sensing device, sensor application ,Direct current motors, Permanent magnet stepper motor, fluid power actuation, fluid power design elements, pie zoelectric actuators. Number system in mechatronics, Binary logic , Karnaugh map minimization, Programmable logic controllers, Introducing to signals, systems, and controls, Laplace transform solutions of ordinary differential equations, System representations, linearization of nonlinear systems, Time delays, measured of systems performance, controller design using pole placement method, elements of data acquisition and control system, transducers and signal conditioning, device for data conversing, data conversion process. Application software

MEL-481 (2-1-0) 3-: Advanced Robotics

Calculation of the Jacobian, Inverse Jacobian ,Dynamic analysis of robot: Lagrangian Mechanics, Effective moment inertia, Dynamic Equation for multiple degree of freedom

robots, Static force analysis of Robots, Transformation of forces and moments between coordinates frames ,Trajectory planning: Path versus Trajectory, Joint space versus Cartesian space Descriptions, Basics of trajectory Planning, Joint space trajectory, Cartesian space Trajectories, Continuous trajectory. Control of manipulators: Open and closed loop control, Linear control schemes. Model of manipulator joint, Joint actuator, Partitioned PD control Schemes, PID control schemes, Computed Torque Control, Force control of Robotics Manipulators tasks, Force control strategy, Hybrid Position/ Force control , Impedance force /Torque control. The DH parameters: As axis placement in 3D space, Transformations in 3D, Euler's Theorem: Chasale's Theorem, Interpolating for general motion in space – finite screws. Jacobian control of planar linkage: Pseudo inverse and Redundant system, Infinitesimal screws, Jacobians for 3D manipulators Kinematics of redundant systems. Parallel manipulators: Some configurations of parallel manipulators, Forward kinematics, Inverse Kinematics, Dynamics. Serial manipulators: Inverse Dynamics of serial manipulators, Forward Dynamics of serial manipulators. Position control of manipulators: Force control of manipulators, Hybrid control strategies, Variable structure control, Impedance control

MEL-486 (2-0-2) 3-: Signal Processing, AI & NN Technique

Basic Elements of Digital Signal Processing Systems, Classification of Signals, The concept of frequency in Continuous time and Discrete time domain, Discrete-time Signals and Systems, Analysis of Discrete Time, Linear Shift Invariant Systems-Linearity, Causality and Stability criterion, AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation, Searching : Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Greedy best first search, A* search Game Playing: Adversial search, Games, minimax, algorithm, optimal decisions in multiplayer games, Knowledge Representation & Reasons logical Agents, Resolution, Forward & Backward. Chaining, Characteristics of Neural Networks, Historical Development of Neural Networks Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws, Pattern Recognition Problem, Basic Functional Units, Pattern Recognition Tasks by the Functional Units..Feed-forward Neural Networks: Analysis of pattern Association Networks, Pattern Classification Networks, pattern storage Networks. Pattern Mapping Networks., Linear Auto associative FF Networks, Pattern Storage Networks, Competitive Learning Neural Networks & Complex pattern Recognition.

Department of Computer Science and Engineering
& Information Technology

The Departments has earned a formidable reputation of providing an impeccable quality of education since 1996. The department provides adequate opportunities for student and researchers to learn and innovate and constantly modernizes the infrastructure and lab facilities through NCU as well as industry. The department has distinguished faculty, most of them holding M. Tech / PhD degree from renowned institutes in India and abroad.

Programmes offered by the Department:

1. Master of Technology in Computer Science & Engineering (3-years Part Time)
   with specialization in:
   - Data Sciences
   - Cyber Security & Forensics

2. Bachelor of Technology in Computer Science & Engineering
   with specialization in:
   - Full Stack Development
   - Cyber Security & Forensics
   - Blockchain
   - Cloud Computing
   - Artificial Intelligence and Machine Learning
   - Data Science
   - Gaming, Augmented Reality and Virtual Reality
3. Bachelor of Computer Applications
   with specialization in:
   - Animation and Gaming
   - Web Application Development

Specializations in Computer Science & Engineering

Full Stack Development

> *"Coding is like writing, and we live in a time of the new industrial revolution. What's happened is that maybe everybody knows how to use computers, like they know how to read, but they don't know how to write."*

said Susan Wojcicki, CEO of YouTube, clearly signifies that coding is one of the most valuable skills anyone can learn today.

B-Tech CSE with Full Stack specialization prepares the student to become an expert at Front-end and Back-end technologies by employing the most popular JAM (Java, Angular and MongoDB) Stack. Students will learn to create web applications from the ground-up with the right engineering disciplines and methodologies in a corporate aligned culture with detailed emphasis on Dev-Ops and Agile (SCRUM) principles.

Cyber Security & Forensics

> *"In Cyber security, the more systems we secure, the more secure we all are"*

stated by Jed Johnson, Former United States Secretary of Homeland Security emphasize on securing the digital world.

B-Tech CSE with specialization in Cyber Security & Forensics equips students with the foundation concepts underlying the secure systems. The curriculum involves hands-on practice sessions to develop skills required for understanding vulnerabilities of existing systems and building systems that defend against escalating cyber threats.

Blockchain

Blockchain is becoming an inevitable phenomenon owing to the core-enabling technologies and significant opportunities it offers to digital businesses. With numerous businesses across various industry verticals adopting blockchain at a rapid pace, it is evident that blockchain is transforming into a movement and is steadily moving towards the next phase of the blockchain revolution.

B-Tech CSE with Blockchain specialization includes a blend of theoretical concepts and practical practice sessions to enable students understand and implement Blockchain based applications. The curriculum lays a strong mathematical foundation of Blockchain fundamentals covering the structure of Blockchain to designing of own Blockchain. The technologies like Big data. Cloud and Web development are also included with Blockchain's perspective.

Cloud Computing

"At this point, cloud adoption is mainstream, and Adoption of next-generation solutions are almost always 'cloud-enhanced' solutions"

as said by [Sid Nag](), research Vice President at Gartner, clearly signifies that all organizations would build on the strengths of a cloud platform to deliver digital business capabilities.

B.Tech. CSE with Cloud Computing specialization offers students with theory and practice to enable them to understand and implement cloud-based applications. The curriculum lays the foundation of cloud computing fundamentals covering all major service providers including Google cloud, AWS and Microsoft Azure.

Artificial Intelligence and Machine Learning

"Our intelligence is what makes us human, and AI is an extension of that quality."
– Yann LeCun Professor, New York University

B-Tech CSE with Artificial Intelligence and Machine Learning specialization offers students with theoretical and practical knowledge of computational tools that are the need of real world applications such as linguistics, health, bioinformatics, economics, education, social network analysis, games etc. The curriculum lays the foundation of Artificial Intelligence and Machine Learning fundamentals including Probability and Statistics, Tensorflow, Applied Artificial Intelligence, Natural Language Processing, Robotics, Computer Vision etc. Companies such as Google, IBM, Microsoft, and other leading players have actively implemented AI as a crucial part of their technologies.

Data Science

"We are drowning in information and starving for knowledge"— John Naisbitt

B-Tech CSE with Data Science specialization offers students with theory and practice to enable them to understand and implement business-based applications. The curriculum lays the foundation of data science fundamentals including Probability and Statistics, Data Engineering, Machine Learning, Google Cloud Platform, Tableau, Knime etc. With a focus towards the ability to unravel insights from shapeless data and convey their findings in a language that their business stakeholders can comprehend, data science experts are needed in virtually every job sector—not just in technology.

Game Tech, AR & VR

"You can push the bounds of your imagination and we have the resources tailored to bring your immersive vision to life" – Unity

B-Tech CSE with Gaming AR, VR specialization offers students with in-depth knowledge which will enable them to understand and industrial usability and implementation of Game technologies, Augmented and Virtual reality applications/simulations. This specialization gives an opportunity by working with these technologies and a focused degree with strong tech foundation, combining rigorous taught components with studio based learning and critical thinking.

Department of Computer Science and Engineering
Master of Technology in Computer Science and Engineering
with Specialization in Data Science

Basic Science Courses   **L-T-P**   **C**

		L-T-P	C
MAL606	Introduction to Research Methodology	2-1-0	3

Program Core   **L-T-P**   **C**

		L-T-P	C
CSL501	Mathematical Foundations of Computer Science	3-0-0	3
CSL535	Advanced Data Structure	2-0-2	3
CSL502	Advanced Algorithms	2-0-2	3
CSL534	Programming Course	3-0-2	4

Open Elective Courses   **L-T-P**   **C**

		L-T-P	C
	Open Elective – 1	2-0-2	3
	Open Elective – 2	2-0-2	3

*Open electives can be chosen from University list of

  Open Elective courses

  *Upto 20% of courses can be done through MOOC courses subject to department approval

Program/Specialization Electives (PE1 – PE6)

                               L-T-P   **C**

		L-T-P	C
CSL551	Foundations Of Data Science	2-0-2	3
CSL553	Analytic Databases	2-0-2	3
CSL555	Machine Learning for Data Science	2-0-2	3
CSL552	Cloud Computing	2-0-2	3
CSL554	Text and Web Intelligence Analytics	2-0-2	3
CSL545	Big Data Analytics	2-0-2	3
CSL557	Social Media Analytics	2-0-2	3
CSL643	Spatial and Temporal Data Analytics	2-0-2	3

Project & Dissertations (P)   **L-T-P**   **C**

		L-T-P	C
CSC602	Seminar	0-0-2	1
CSD601	Dissertation (Phase-1)	0-0-8	4
CSL602	Dissertation (Phase-2)	0-0-24	12

Department of Computer Science and Engineering

Master of Technology in Computer Science and Engineering with Specialization in Cyber Security and Forensics

Basic Science Courses

		L-T-P	C
MAL606	Introduction to Research Methodology	2-1-0	3

Program Core

		L-T-P	C
CSL501	Mathematical Foundations of Computer Science	3-0-0	3
CSL535	Advanced Data Structure	2-0-2	3
CSL502	Advanced Algorithms	2-0-2	3
CSL534	Programming Course	3-0-2	4

Open Elective Courses

		L-T-P	C
	Open Elective – 1	2-0-2	3
	Open Elective – 2	2-0-2	3

*Open electives can be chosen from University list of Open Elective courses

*Upto 20% of courses can be done through MOOC courses subject to department approval

Program/Specialization Electives

		L-T-P	C
CSL543	Cyber Security	2-0-2	3
CSL536	Intrusion Detection and Prevention System	2-0-2	3
CSL537	Risk Management Policies and Principles	2-0-2	3
CSL539	Digital Forensics	2-0-2	3
CSL541	Security in Distributed System	2-0-2	3
CSL538	Secure Coding and Software Vulnerability Lab	2-0-2	3
CSL542	Reverse Engineering and Malware Analysis	2-0-2	3
CSL613	Applied Cryptography	2-0-2	3

Project & Dissertations (P)

		L-T-P	C
CSC602	Seminar	0-0-2	1
CSD601	Dissertation (Phase-1)	0-0-8	4
CSL602	Dissertation (Phase-2)	0-0-24	12

M.Tech. Computer Science and Engineering 2021-22 (3- years Part Time)
(Specialization offered in Data Science/ Cyber Security and Forensics)

Sem	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	L	T	P	Weekly Contact Hours	Credits
I	CSL501 Mathematical Foundations of Computer Science 3-0-0 (3)	CSL535 Advanced Data Structure 2-0-2 (3)	PE-1 2-0-2 (3)	OE-1 2-0-2 (3)		9	0	6	15	12
II	CSL502 Advanced Algorithms 2-0-2 (3)	OE-2 2-0-2 (3)	MAL606 Research Methodology 2-1-0 (3)			6	1	4	11	9
III	CSL534 Programming Course 3-0-2 (4)	PE-2 2-0-2 (3)	PE-3 2-0-2 (3)			7	0	6	13	10
IV	PE-4 2-0-2 (3)	PE-5 2-0-2 (3)	PE-6 2-0-2 (3)			6	0	6	12	9
V	CSD601 Dissertation-I 0-0-8 (4)	CSC602 Seminar 0-0-2 (1)				0	0	10	10	5
VI	CSD602 Dissertation-II 0-0-24 (12)					0	0	24	24	12
	Total Credits of the Programme: 57									

*PE – Programme Elective   * OE – Open Elective

Specialization Electives (PE)

Data Science Specialization	Cyber Security Specialization
• Analytic Databases	• Applied Cryptography
• Machine Learning for Data Science	• Cyber Security
• Cloud Computing	• Intrusion Detection and Prevention System
• Text and Web Intelligence Analytics	• Risk Management Policies and Principles
• Big Data Analytics	• Digital Forensics
• Media Analytics	• Security in Distributed System
• Spatial and Temporal Data Analytics	• Secure Coding and Software Vulnerability Lab
• Social Media Analytics	• Reverse Engineering and Malware Analysis

Department of Computer Science and Engineering

Bachelor of Technology in Computer Science & Engineering with Specialization in Full Stack Development

Basic Science Courses

Code	Course	L-T-P	C
MAL151	Engineering Maths -I	3-0-2	4
MAL152	Engineering Maths -II	3-0-2	4
PHY150	Engineering Physics	3-0-2	4
CHL150	Engineering Chemistry	2-0-2	3

Engineering Science Courses

Code	Course	L-T-P	C
CSL106	FOCP I	2-0-4	4
CSL108	FOCP II	2-0-4	4
MEP110	Engineering Graphics & Drawing	1-0-4	3
MEL150	Basics of Mechanical and Civil Engineering	2-0-2	3
ECL 110	Basics of Electrical & Electronics Engineering	2-0-2	3
CSL110	Problem Solving and design thinking	2-0-2	3

Program Core

Code	Course	L-T-P	C
CSL223	Discrete Mathematics	3-0-2	4
CSL209	Data Structures	3-0-2	4
CSL214	Database Management Systems	3-0-2	4
CSL203	Operating Systems	3-0-2	4
CSL229	Software Engineering and Project Management	3-0-2	4
CSL230	Analysis and Design of Algorithms	3-0-2	4
CSL240	Computer Networks	3-0-2	4
CSL318	Theory of Computation (MOOC)	3-0-2	4
ECL255	Digital Electronics and Computer Architecture	3-0-2	4
CSL422	Cyber Security	3-0-2	4
CSL236/ CSL242	Introduction to AI & ML / AI for Games	3-0-2	4
SEG400	Self Study Course GATE	Audit	

General Proficiency

Code	Course	C
CSR118	General Proficiency-I	1
CSR119	General Proficiency -II	1
CSR218	General Proficiency -III	1
CSR219	General Proficiency -IV	1
CSR318	General Proficiency -V	1
CSR319	General Proficiency -VI	1

Program/Specialization Electives

Code	Course	L-T-P	C
CSL273	Enterprise Web Applications	2-0-4	4
CSL274	Middleware Frameworks and ORM	2-0-4	4
CSL276	NoSQL	2-0-4	4
CSL253	Web Frameworks	2-0-4	4
CSL371	Mobile Application Development	2-0-4	4
CSL373	DevOps	2-0-4	4
CSL311	Big Data	2-0-4	4
CSL374	Microservice Based Application	2-0-4	4

Humanities and Management Courses

Code	Course	L-T-P	C
CLL101	Effective Communications I	2-1-0	2.5
CLL102	Effective Communications II	2-1-0	2.5
SML300	Entrepreneurship	3-0-0	3

University-Wide Compulsory Courses

Code	Course	L-T-P	C
CHL100	Environmental Studies	3-0-0	3
CLL120	Human Values and Professional Ethics	2-0-0	2
CLP300	Campus to Corporate	1-0-0	1

Other Mandatory Courses

	Course	L-T-P	C
	Open Elective – 1	3-0-0	3
	Open Elective – 2	3-0-0	3
	Open Elective – 3	3-0-0	3
	Open Elective – 4	3-0-0	3
	Open Elective – 5	3-0-0	3
	Foreign Language Elective	3-0-0	3
	Liberal Arts Course	3-0-0	3

Project & Internship (P)

Code	Course	L-T-P	C
CSD401	Project – I		4
CSD402	Project – II/ Internship		6
CSV201	Skill Development	1-0-2	2
CSC301	Seminar		1
CST201	Practical Training		2
CST301	Industrial Internship		3

- Upto 20% of courses can be done through MOOC courses subject to department approval
- Open electives, Foreign Elective and Liberal Art Courses can be chosen from University list of Open Elective courses
- Minimum six program electives for certification in specialization.

Department of Computer Science and Engineering

Bachelor of Technology in Computer Science & Engineering with Specialization in Cyber Security & Forensics

Basic Science Courses

		L-T-P	C
MAL151	Engineering Maths -I	3-0-2	4
MAL152	Engineering Maths -II	3-0-2	4
PHY150	Engineering Physics	3-0-2	4
CHL150	Engineering Chemistry	2-0-2	3

Engineering Science Courses

		L-T-P	C
CSL106	FOCP I	2-0-4	4
CSL108	FOCP II	2-0-4	4
MEP110	Engineering Graphics & Drawing	1-0-4	3
MEL150	Basics of Mechanical and Civil Engineering	2-0-2	3
ECL 110	Basics of Electrical & Electronics Engineering	2-0-2	3
CSL110	Problem Solving and design thinking	2-0-2	3

Program Core

		L-T-P	C
CSL223	Discrete Mathematics	3-0-2	4
CSL209	Data Structures	3-0-2	4
CSL214	Database Management Systems	3-0-2	4
CSL203	Operating Systems	3-0-2	4
CSL229	Software Engineering and Project Management	3-0-2	4
CSL230	Analysis and Design of Algorithms	3-0-2	4
CSL240	Computer Networks	3-0-2	4
CSL318	Theory of Computation (MOOC)	3-0-2	4
ECL255	Digital Electronics and Computer Architecture	3-0-2	4
CSL422	Cyber Security	3-0-2	4
CSL236/ CSL242	Introduction to AI & ML / AI for Games	3-0-2	4
SEG400	Self Study Course GATE	Audit	

General Proficiency

		C
CSR118	General Proficiency-I	1
CSR119	General Proficiency -II	1
CSR218	General Proficiency -III	1
CSR219	General Proficiency -IV	1
CSR318	General Proficiency -V	1
CSR319	General Proficiency -VI	1

Program/Specialization Electives

		L-T-P	C
CSL281	Secure Communication and Cryptography	2-0-4	4
CSL283	Secure Coding and Vulnerabilities	2-0-4	4
CSL284	Digital Forensics and Malware Analysis	2-0-4	4
CSL383	Network Security	2-0-4	4
CSL387	Web and Mobile Security	2-0-4	4
CSL384	Cloud Security Essentials	2-0-4	4
CSL385	Risk Analysis & Assessment	2-0-4	4
CSL382	Blockchain	2-0-4	4

Humanities and Management Courses

		L-T-P	C
CLL101	Effective Communications I	2-1-0	2.5
CLL102	Effective Communications II	2-1-0	2.5
SML300	Entrepreneurship	3-0-0	3

University-Wide Compulsory Courses

		L-T-P	C
CHL100	Environmental Studies	3-0-0	3
CLL120	Human Values and Professional Ethics	2-0-0	2
CLP300	Campus to Corporate	1-0-0	1

Other Mandatory Courses

		L-T-P	C
	Open Elective – 1	3-0-0	3
	Open Elective – 2	3-0-0	3
	Open Elective – 3	3-0-0	3
	Open Elective – 4	3-0-0	3
	Open Elective – 5	3-0-0	3
	Foreign Language Elective	3-0-0	3
	Liberal Arts Course	3-0-0	3

Project & Internship (P)

		L-T-P	C
CSD401	Project – I		4
CSD402	Project – II/ Internship		6
CSV201	Skill Development	1-0-2	2
CSC301	Seminar		1
CST201	Practical Training		2
CST301	Industrial Internship		3

- Upto 20% of courses can be done through MOOC courses subject to department approval
- Open electives, Foreign Elective and Liberal Art Courses can be chosen from University list of Open Elective courses
- Minimum six program electives for certification in specialization.

Department of Computer Science and Engineering

Bachelor of Technology in Computer Science & Engineering with Specialization in Blockchain

Basic Science Courses

		L-T-P	C
MAL151	Engineering Maths -I	3-0-2	4
MAL152	Engineering Maths -II	3-0-2	4
PHY150	Engineering Physics	3-0-2	4
CHL150	Engineering Chemistry	2-0-2	3

Engineering Science Courses

		L-T-P	C
CSL106	FOCP I	2-0-4	4
CSL108	FOCP II	2-0-4	4
MEP110	Engineering Graphics & Drawing	1-0-4	3
MEL150	Basics of Mechanical and Civil Engineering	2-0-2	3
ECL 110	Basics of Electrical & Electronics Engineering	2-0-2	3
CSL110	Problem Solving and design thinking	2-0-2	3

Program Core

		L-T-P	C
CSL223	Discrete Mathematics	3-0-2	4
CSL209	Data Structures	3-0-2	4
CSL214	Database Management Systems	3-0-2	4
CSL203	Operating Systems	3-0-2	4
CSL229	Software Engineering and Project Management	3-0-2	4
CSL230	Analysis and Design of Algorithms	3-0-2	4
CSL240	Computer Networks	3-0-2	4
CSL318	Theory of Computation (MOOC)	3-0-2	4
ECL255	Digital Electronics and Computer Architecture	3-0-2	4
CSL422	Cyber Security	3-0-2	4
CSL236/ CSL242	Introduction to AI & ML / AI for Games	3-0-2	4
SEG400	Self Study Course GATE	Audit	

General Proficiency

		C
CSR118	General Proficiency-I	1
CSR119	General Proficiency -II	1
CSR218	General Proficiency -III	1
CSR219	General Proficiency -IV	1
CSR318	General Proficiency -V	1
CSR319	General Proficiency -VI	1

Program/Specialization Electives

		L-T-P	C
CSL239	Mathematics of Modern Cryptography	2-0-4	4
CSL247	Introduction to blockchain technologies	2-0-4	4
CSL355	Bitcoin and Cryptocurrency Technologies	2-0-4	4
CSL356	Smart Contracts	2-0-4	4
CSL357	Blockchain for Cyber Security	2-0-4	4
CSL358	Blockchain Technology in Web Development	2-0-4	4
CSL449	Security and Privacy for Big Data Analytics	2-0-4	4
CSL455	Cloud Infrastructure and Services	2-0-4	4

Humanities and Management Courses

		L-T-P	C
CLL101	Effective Communications I	2-1-0	2.5
CLL102	Effective Communications II	2-1-0	2.5
SML300	Entrepreneurship	3-0-0	3

University-Wide Compulsory Courses

		L-T-P	C
CHL100	Environmental Studies	3-0-0	3
CLL120	Human Values and Professional Ethics	2-0-0	2
CLP300	Campus to Corporate	1-0-0	1

Other Mandatory Courses

		L-T-P	C
	Open Elective – 1	3-0-0	3
	Open Elective – 2	3-0-0	3
	Open Elective – 3	3-0-0	3
	Open Elective – 4	3-0-0	3
	Open Elective – 5	3-0-0	3
	Foreign Language Elective	3-0-0	3
	Liberal Arts Course	3-0-0	3

Project & Internship (P)

		L-T-P	C
CSD401	Project – I		4
CSD402	Project – II/ Internship		6
CSV201	Skill Development	1-0-2	2
CSC301	Seminar		1
CST201	Practical Training		2
CST301	Industrial Internship		3

- Upto 20% of courses can be done through MOOC courses subject to department approval
- Open electives, Foreign Elective and Liberal Art Courses can be chosen from University list of Open Elective courses
- Minimum six program electives for certification in specialization.

Department of Computer Science and Engineering

Bachelor of Technology in Computer Science & Engineering with Specialization in Cloud Computing

Basic Science Courses

Code	Course	L-T-P	C
MAL151	Engineering Maths -I	3-0-2	4
MAL152	Engineering Maths -II	3-0-2	4
PHY150	Engineering Physics	3-0-2	4
CHL150	Engineering Chemistry	2-0-2	3

Engineering Science Courses

Code	Course	L-T-P	C
CSL106	FOCP I	2-0-4	4
CSL108	FOCP II	2-0-4	4
MEP110	Engineering Graphics & Drawing	1-0-4	3
MEL150	Basics of Mechanical and Civil Engineering	2-0-2	3
ECL 110	Basics of Electrical & Electronics Engineering	2-0-2	3
CSL110	Problem Solving and design thinking	2-0-2	3

Program Core

Code	Course	L-T-P	C
CSL223	Discrete Mathematics	3-0-2	4
CSL209	Data Structures	3-0-2	4
CSL214	Database Management Systems	3-0-2	4
CSL203	Operating Systems	3-0-2	4
CSL229	Software Engineering and Project Management	3-0-2	4
CSL230	Analysis and Design of Algorithms	3-0-2	4
CSL240	Computer Networks	3-0-2	4
CSL318	Theory of Computation (MOOC)	3-0-2	4
ECL255	Digital Electronics and Computer Architecture	3-0-2	4
CSL422	Cyber Security	3-0-2	4
CSL236/ CSL242	Introduction to AI & ML / AI for Games	3-0-2	4
SEG400	Self Study Course GATE	Audit	

General Proficiency

Code	Course	C
CSR118	General Proficiency-I	1
CSR119	General Proficiency -II	1
CSR218	General Proficiency -III	1
CSR219	General Proficiency -IV	1
CSR318	General Proficiency -V	1
CSR319	General Proficiency -VI	1

Program/Specialization Electives

Code	Course	L-T-P	C
CSL225	Programming for Data Science	2-0-4	4
CSL238	Introduction to Cloud Computing	2-0-4	4
CSL337	Cloud Architecture	2-0-4	4
CSL338	Virtualization & Cloud Computing	2-0-4	4
CSL339	Big Data on Cloud	2-0-4	4
CSL346	Artificial Intelligence & Machine Learning on Cloud	2-0-4	4
CSL445	Cloud Application Development & Deployment	2-0-4	4
CSL446	Cloud Security	2-0-4	4

Humanities and Management Courses

Code	Course	L-T-P	C
CLL101	Effective Communications I	2-1-0	2.5
CLL102	Effective Communications II	2-1-0	2.5
SML300	Entrepreneurship	3-0-0	3

University-Wide Compulsory Courses

Code	Course	L-T-P	C
CHL100	Environmental Studies	3-0-0	3
CLL120	Human Values and Professional Ethics	2-0-0	2
CLP300	Campus to Corporate	1-0-0	1

Other Mandatory Courses

Code	Course	L-T-P	C
	Open Elective – 1	3-0-0	3
	Open Elective – 2	3-0-0	3
	Open Elective – 3	3-0-0	3
	Open Elective – 4	3-0-0	3
	Open Elective – 5	3-0-0	3
	Foreign Language Elective	3-0-0	3
	Liberal Arts Course	3-0-0	3

Project & Internship (P)

Code	Course	L-T-P	C
CSD401	Project – I		4
CSD402	Project – II/ Internship		6
CSV201	Skill Development	1-0-2	2
CSC301	Seminar		1
CST201	Practical Training		2
CST301	Industrial Internship		3

- Upto 20% of courses can be done through MOOC courses subject to department approval
- Open electives, Foreign Elective and Liberal Art Courses can be chosen from University list of Open Elective courses
- Minimum six program electives for certification in specialization.

Department of Computer Science and Engineering

Bachelor of Technology in Computer Science & Engineering with Specialization in Artificial Intelligence and Machine Learning

Basic Science Courses

		L-T-P	C
MAL151	Engineering Maths -I	3-0-2	4
MAL152	Engineering Maths -II	3-0-2	4
PHY150	Engineering Physics	3-0-2	4
CHL150	Engineering Chemistry	2-0-2	3

Engineering Science Courses

		L-T-P	C
CSL106	FOCP I	2-0-4	4
CSL108	FOCP II	2-0-4	4
MEP110	Engineering Graphics & Drawing	1-0-4	3
MEL150	Basics of Mechanical and Civil Engineering	2-0-2	3
ECL 110	Basics of Electrical & Electronics Engineering	2-0-2	3
CSL110	Problem Solving and design thinking	2-0-2	3

Program Core

		L-T-P	C
CSL223	Discrete Mathematics	3-0-2	4
CSL209	Data Structures	3-0-2	4
CSL214	Database Management Systems	3-0-2	4
CSL203	Operating Systems	3-0-2	4
CSL229	Software Engineering and Project Management	3-0-2	4
CSL230	Analysis and Design of Algorithms	3-0-2	4
CSL240	Computer Networks	3-0-2	4
CSL318	Theory of Computation (MOOC)	3-0-2	4
ECL255	Digital Electronics and Computer Architecture	3-0-2	4
CSL422	Cyber Security	3-0-2	4
CSL236/ CSL242	Introduction to AI & ML / AI for Games	3-0-2	4
SEG400	Self Study Course GATE	Audit	

General Proficiency

		C
CSR118	General Proficiency-I	1
CSR119	General Proficiency -II	1
CSR218	General Proficiency -III	1
CSR219	General Proficiency -IV	1
CSR318	General Proficiency -V	1
CSR319	General Proficiency -VI	1

Program/Specialization Electives

		L-T-P	C
CSL 225	Programming for Data Science and AI	2-0-4	4
CSL227	Applied Computational Statistics	2-0-4	4
CSL347	Applied Artificial Intelligence and Expert Systems	2-0-4	4
CSL348	Reinforcement Learning	2-0-4	4
CSL349	Artificial Intelligence for Robotics	2-0-4	4
CSL312	Deep Learning	2-0-4	4
CSL447	Computer Vision	2-0-4	4
CSL448	Computational Linguistics and Natural Language Processing	2-0-4	4

Humanities and Management Courses

		L-T-P	C
CLL101	Effective Communications I	2-1-0	2.5
CLL102	Effective Communications II	2-1-0	2.5
SML300	Entrepreneurship	3-0-0	3

University-Wide Compulsory Courses

		L-T-P	C
CHL100	Environmental Studies	3-0-0	3
CLL120	Human Values and Professional Ethics	2-0-0	2
CLP300	Campus to Corporate	1-0-0	1

Other Mandatory Courses

		L-T-P	C
	Open Elective – 1	3-0-0	3
	Open Elective – 2	3-0-0	3
	Open Elective – 3	3-0-0	3
	Open Elective – 4	3-0-0	3
	Open Elective – 5	3-0-0	3
	Foreign Language Elective	3-0-0	3
	Liberal Arts Course	3-0-0	3

Project & Internship (P)

		L-T-P	C
CSD401	Project – I		4
CSD402	Project – II/ Internship		6
CSV201	Skill Development	1-0-2	2
CSC301	Seminar		1
CST201	Practical Training		2
CST301	Industrial Internship		3

- Upto 20% of courses can be done through MOOC courses subject to department approval
- Open electives, Foreign Elective and Liberal Art Courses can be chosen from University list of Open Elective courses
- Minimum six program electives for certification in specialization.

Department of Computer Science and Engineering

Bachelor of Technology in Computer Science & Engineering with Specialization in Data Science

Basic Science Courses

		L-T-P	C
MAL151	Engineering Maths -I	3-0-2	4
MAL152	Engineering Maths -II	3-0-2	4
PHY150	Engineering Physics	3-0-2	4
CHL150	Engineering Chemistry	2-0-2	3

Engineering Science Courses

		L-T-P	C
CSL106	FOCP I	2-0-4	4
CSL108	FOCP II	2-0-4	4
MEP110	Engineering Graphics & Drawing	1-0-4	3
MEL150	Basics of Mechanical and Civil Engineering	2-0-2	3
ECL 110	Basics of Electrical & Electronics Engineering	2-0-2	3
CSL110	Problem Solving and design thinking	2-0-2	3

Program Core

		L-T-P	C
CSL223	Discrete Mathematics	3-0-2	4
CSL209	Data Structures	3-0-2	4
CSL214	Database Management Systems	3-0-2	4
CSL203	Operating Systems	3-0-2	4
CSL229	Software Engineering and Project Management	3-0-2	4
CSL230	Analysis and Design of Algorithms	3-0-2	4
CSL240	Computer Networks	3-0-2	4
CSL318	Theory of Computation (MOOC)	3-0-2	4
ECL255	Digital Electronics and Computer Architecture	3-0-2	4
CSL422	Cyber Security	3-0-2	4
CSL236/ CSL242	Introduction to AI & ML / AI for Games	3-0-2	4
SEG400	Self Study Course GATE	Audit	

General Proficiency

		C
CSR118	General Proficiency-I	1
CSR119	General Proficiency -II	1
CSR218	General Proficiency -III	1
CSR219	General Proficiency -IV	1
CSR318	General Proficiency -V	1
CSR319	General Proficiency -VI	1

Program/Specialization Electives

		L-T-P	C
CSL225	Programming for Data Science	2-0-4	4
CSL227	Applied Computational Statistics	2-0-4	4
CSL232	Business Intelligence & Data Visualization	2-0-4	4
CSL234	Data Engineering	2-0-4	4
CSL313	Machine Learning	2-0-4	4
CSL311	Big Data	2-0-4	4
CSL316	Introduction to Image Processing and Recognition	2-0-4	4
CSL312	Deep Learning	2-0-4	4

Humanities and Management Courses

		L-T-P	C
CLL101	Effective Communications I	2-1-0	2.5
CLL102	Effective Communications II	2-1-0	2.5
SML300	Entrepreneurship	3-0-0	3

University-Wide Compulsory Courses

		L-T-P	C
CHL100	Environmental Studies	3-0-0	3
CLL120	Human Values and Professional Ethics	2-0-0	2
CLP300	Campus to Corporate	1-0-0	1

Other Mandatory Courses

		L-T-P	C
	Open Elective – 1	3-0-0	3
	Open Elective – 2	3-0-0	3
	Open Elective – 3	3-0-0	3
	Open Elective – 4	3-0-0	3
	Open Elective – 5	3-0-0	3
	Foreign Language Elective	3-0-0	3
	Liberal Arts Course	3-0-0	3

Project & Internship (P)

		L-T-P	C
CSD401	Project – I		4
CSD402	Project – II/ Internship		6
CSV201	Skill Development	1-0-2	2
CSC301	Seminar		1
CST201	Practical Training		2
CST301	Industrial Internship		3

- Upto 20% of courses can be done through MOOC courses subject to department approval
- Open electives, Foreign Elective and Liberal Art Courses can be chosen from University list of Open Elective courses
- Minimum six program electives for certification in specialization.

Department of Computer Science and Engineering

Bachelor of Technology in Computer Science & Engineering with Specialization in Gaming, AR & VR

NCU
THE NORTHCAP UNIVERSITY
Bridging the gap between the classroom and the real world
NAAC ACCREDITED
(Formerly ITM University, Gurugram)

Basic Science Courses

		L-T-P	C
MAL151	Engineering Maths -I	3-0-2	4
MAL152	Engineering Maths -II	3-0-2	4
PHY150	Engineering Physics	3-0-2	4
CHL150	Engineering Chemistry	2-0-2	3

Engineering Science Courses

		L-T-P	C
CSL106	FOCP I	2-0-4	4
CSL108	FOCP II	2-0-4	4
MEP110	Engineering Graphics & Drawing	1-0-4	3
MEL150	Basics of Mechanical and Civil Engineering	2-0-2	3
ECL 110	Basics of Electrical & Electronics Engineering	2-0-2	3
CSL110	Problem Solving and design thinking	2-0-2	3

Program Core

		L-T-P	C
CSL223	Discrete Mathematics	3-0-2	4
CSL209	Data Structures	3-0-2	4
CSL214	Database Management Systems	3-0-2	4
CSL203	Operating Systems	3-0-2	4
CSL229	Software Engineering and Project Management	3-0-2	4
CSL230	Analysis and Design of Algorithms	3-0-2	4
CSL240	Computer Networks	3-0-2	4
CSL318	Theory of Computation (MOOC)	3-0-2	4
ECL255	Digital Electronics and Computer Architecture	3-0-2	4
CSL422	Cyber Security	3-0-2	4
CSL236/ CSL242	Introduction to AI & ML / AI for Games	3-0-2	4
SEG400	Self Study Course GATE	Audit	

General Proficiency

		C
CSR118	General Proficiency-I	1
CSR119	General Proficiency -II	1
CSR218	General Proficiency -III	1
CSR219	General Proficiency -IV	1
CSR318	General Proficiency -V	1
CSR319	General Proficiency -VI	1

Program/Specialization Electives

		L-T-P	C
CSL243	Game Design and Asset Creation	2-0-4	4
CSL245	Programming for Games	2-0-4	4
CSL244	Advanced Programming for Games	2-0-4	4
CSL343	Designing Human Computer Interfaces	2-0-4	4
CSL246	Cross Platform Game Development	2-0-4	4
CSL341	AR Development	2-0-4	4
CSL345	VR Development	2-0-4	4
CSL342	XR Studio	2-0-4	4

Humanities and Management Courses

		L-T-P	C
CLL101	Effective Communications I	2-1-0	2.5
CLL102	Effective Communications II	2-1-0	2.5
SML300	Entrepreneurship	3-0-0	3

University-Wide Compulsory Courses

		L-T-P	C
CHL100	Environmental Studies	3-0-0	3
CLL120	Human Values and Professional Ethics	2-0-0	2
CLP300	Campus to Corporate	1-0-0	1

Other Mandatory Courses

		L-T-P	C
	Open Elective – 1	3-0-0	3
	Open Elective – 2	3-0-0	3
	Open Elective – 3	3-0-0	3
	Open Elective – 4	3-0-0	3
	Open Elective – 5	3-0-0	3
	Foreign Language Elective	3-0-0	3
	Liberal Arts Course	3-0-0	3

Project & Internship (P)

		L-T-P	C
CSD401	Project – I		4
CSD402	Project – II/ Internship		6
CSV201	Skill Development	1-0-2	2
CSC301	Seminar		1
CST201	Practical Training		2
CST301	Industrial Internship		3

- Upto 20% of courses can be done through MOOC courses subject to department approval
- Open electives, Foreign Elective and Liberal Art Courses can be chosen from University list of Open Elective courses
- Minimum six program electives for certification in specialization.

Bachelor of Technology in 'Computer Science and Engineering- (2021-22)

Sem	Semester Course Code, Course Name (L-T-P)Credits						GP	Community Services	Hrs. Per week			Credits
									L	T	P	
1	MAL151 Engg Maths-I (3-0-2)4	CSL106 FOCP-I (2-0-4)4	CHL150 Engg Chemistry (2-0-2)3	CLL101 Effective Communication-I (2-1-0)2.5	MEP110 Engineering Graphics & Drawing (1-0-4)3	CSL110 Problem Solving and Design Thinking (2-0-2)3	CSR118 GP 1 Credit	CSS101 CS-I (70 Hrs)	12	1	14	19.5+1 =20.5
2	MAL152 Engg Maths-II (3-0-2)4	CSL108 FOCP-II (2-0-4)4	PHY150 Engineering Physics (3-0-2)4	CLL102 Effective Communication-II (2-1-0)2.5	MEL150 Basic of Mechanical & Civil Engg. (2-0-2)	ECL110 Basic of Electrical & Electronics Engineering (2-0-2)3	CSR119 GP 1 Credit	CSS102 CS-II (70 Hrs) 2 Credits	14	1	12	20.5+3 =23.5
Summer	Community Service (Remaining Hours)											
3	CSL209 Data Structures (3-0-2)4	ECL255 DE & CA (3-0-2)4	CSL240 Computer Networks (3-0-2)4	CSL223 Discrete Mathematics (3-0-0)3	Program Elective - I (2-0-4)4	CSV201 Skill Development* (1-0-2)2	CSR218 GP 1 Credit	CSS201 CS-III (35 Hrs)	15		12	21+1 =22
4	CSL422 Cyber Security (3-0-2)4	CSL214 DBMS (3-0-2)4	CSL230 Analysis and Design of Algorithms (3-0-2)4	Program Elective-2 (2-0-4)4	SML300 Entrepreneurship (3-0-0)3	Open Elective – 4* (MOOC) (3-0-0-)3	CS219 GP 1 Credit	CSS202 CS-IV (35 Hrs) 1 Credit	17		10	22+2 =24
Summer	CST201 Industrial Training/internship (including 70 hrs of community service)											2
5	CSL236 Introduction to AI & ML / CSL242 AI for Games (3-0-2)4	CSL303 Operating System (3-0-2)4	Program Elective-3 (2-0-4)4	Program Elective-4 (2-0-4)4	Open Elective – 1* (MOOC) (3-0-0)3	CLL120 HVPE (2-0-0-)2	CSR318 GP 1 Credit	CSS301 CS-V (35 Hrs)	15		12	21+1 =22
6	CSL229 SEPM (3-0-2)4	Program Elective-5 (2-0-4)4	Program Elective-6 (2-0-4)4	CSL318 Theory of Computation (3-0-2)4	Open Elective-2 (3-0-0)3	CLP300 Campus to Corporate (1-0-0)1	CSC301 Seminar 1 Credit	CSR319 GP 1 Credit	CSS302 CS-VI (35 Hrs) 1 Credit	14		12	21+2 =23
Summer	CST301 Industrial Training (including 70 hrs of community service)											03
7	Program Elective-7 (2-0-4)4	Program Elective-8 (2-0-4)4	CSD401 Project # 1 4 Credits	Open Elective – 3* (MOOC) (3-0-0)3	CHL100 EVS (3-0-0)3	Foreign Language (3-0-0)3		CSS401 CS-VII (70 Hrs)	13		8	21
8	SML*** Liberal Arts (3-0-0)3	Open Elective – 5* (MOOC) (3-0-0)3	CSD402 Project # 2 /Internship 6 Credits					CSS402 CS-VIII (70 Hrs) 2 Credits	6			12+2 =14
Total									106	2	80	163+12= 175

* CSV201 Skill Development (Python to be taught to students with Cyber Security specialization)

Program Electives for each track

Tracks	Data Science	Cloud Computing	Full Stack	Game Tech	Cyber Security	Blockchain	AI & ML	Other Electives
Program Elective-1	CSL 225 Programming for Data Science	CSL225 Programming for Data Science	CSL273 Enterprise Web Applications	CSL243 Game Design & Asset Creation	CSL 281 Secure Communication and Cryptography	CSL239 Mathematics of Modern Cryptography	CSL 225 Programming for Data Science and AI	MAL270 Numerical Methods
Program Elective-2	CSL227 Applied Computational Statistics	CSL238 Introduction to Cloud Computing	CSL274 Middleware Frameworks and ORM	CSL245 Programing for Games	CSL 283 Secure Coding and Vulnerabilities	CSL247 Intro. to blockchain technologies	CSL227 Applied Computational Statistics	CSL223 Web Development Technologies
Program Elective-3	CSL234 Data Engineering	CSL337 Cloud Architecture	CSL276 No SQL Databases	CSL244 Advanced Programming for Games	CSL 284 Digital Forensics and Malware Analysis	CSL355 Bitcoin and Cryptocurrency Technologies	CSL347 Applied Artificial Intelligence and Expert Systems	MAL280 Linear Algebra and its Applications
Program Elective-4	CSL232 Business Intelligence and Data Visualization	CSL338 Virtualization & Cloud Computing	CSL253 Web Frameworks	CSL343 Designing Human Computer Interfaces	CSL 383 Network security	CSL356 Smart Contracts	CSL348 Reinforcement Learning	MAL260 Probability and Statistics
Program Elective-5	CSL313 Machine Learning	CSL339 Big Data on Cloud	CSL371 Mobile Application Development	CSL246 Cross Platform Game Development	CSL387 Web and Mobile Security	CSL357 Blockchain for Cyber Security	CSL349 Artificial Intelligence for Robotics	
Program Elective-6	CSL311 Big Data	CSL346 Artificial Intelligence & Machine Learning on Cloud	CSL373 Devops	CSL341 AR Development	CSL385 Risk Analysis and Assessment	CSL358 Blockchain Technology in Web Development	CSL312 Deep Learning	
Program Elective-7	CSL316 Introduction to Image Processing and Recognition	CSL445 Cloud Application Development & Deployment	CSL311 Big Data	CSL345 VR Development	CSL384 Cloud Security Essentials	CSL449 Security and Privacy for Big Data Analytics	CSL447 Computer Vision	
Program Elective-8	CSL312 Deep Learning	CSL446 Cloud Security	CSL374 Micro service Based Applications	CSL342 XR Studio	CSL382 Blockchain	CSL455 Cloud Infrastructure and Services	CSL448 Computational Linguistics and Natural Language Processing	

CSL535 Advanced Data Structures
(2-0-2) 3 credits
Introduction to Data Structures, Arrays, recursion, Stacks- Operation on Stack, Pointers and Stacks. Queues- Dynamic Implementation using pointers. Static Lists and Linked Lists- Insertion, deletion, Sorting, Singly Linked List, Doubly Linked List. Storage management- Memory Representation, boundary Tag Systems, Storage Allocation. Trees- Binary Tree, Complete Binary Tree, Binary Search Tree. Graphs- Traversal in Graphs, Spanning Trees, Sorting- Insertion, Selection, Bubble, Quick, Searching- Linear Search, Binary Search, Division Method, Mid Square Method.

CSL502 Advanced Algorithms
(2-0-2) 3 Credits
Introduction to general Algorithm Paradigms: Divide and Conquer, Dynamic Programming, Greedy Method and Backtracking; Algorithm analysis, RAM Model, Recurrence relation, Master theorem, Asymptotic vs. Amortized analysis. Breadth First Search and Application, Depth First Search and Application, Euler Tour, Heaps and Application, Divide and Conquer- Recursive Procedures, Binary Search, Integer Multiplication, Advance Sorting. Backtracking (Recursion/DFS), Branch & Bound(Expansion/BFS),Dynamic Programming: General method, Optimization problems, All Pair Shortest Path, Genetic Algorithms, Genetic Algorithmic operators & Process, Solving TSP using GA, Solving 0/1- knapsack using GA. String-Matching problem - String-matching algorithms: Finite Automata for string matching, Rabin-Karp, Knuth-Morris-Pratt algorithm, Boyer-Moore algorithm, Applications: (virus detection/plagiarism, DNA pattern matching (LCS) in Bioinformatics. NP-Hard problems, Reductions, Approximation algorithm, Performance Ratio, Bin Packing Problem, Approx -Travelling Sales Person- Tour.

CSD 601 Dissertation-I
(0-0-8) 4 Credits
Completion of project, Dissertation and report undertaken as CSD 601

CSD 602 Dissertation-II
(0-0-24) 12 Credits

Completion of projects and report undertaken as CSD 602

CSL501 Mathematical Foundations of Computer Science
(3-0-0) 3 Credits
Introduction, basic elements of Linear algebra, the matrix and the vector, Linear equations & Matrices, Special type of Matrices & Partition Matrices, Vectors in the Plane, Vector Spaces & Subspaces, Linear Independence, Basis & Dimension, The Rank of a matrix, The standard inner product on R3, Inner product spaces, The Gram –Schmidt Process, The Kernel & Range of a Linear Transformation, The Matrix of a Linear transformation, The vector space of Matrices, Eigenvalues & Eigenvectors, Diagonilisation, Diagonilisation of symmetric matrices, Real Quadratic Forms, Complex Eigen values & Eigenvectors, Lines, Planes in Rn, Hyperplanes: Definition, normal vector, normal equation for the hyperplane, decision boundary, Hyper surface, Affine hyper planes, Optimum Separation Hyper plane, Non-linear Classification and the Kernel trick.

CSL534 Big Data Analytics
(3-0-2) 4 Credits
Big data, Characteristics of big data, structured data, semi- structured data, and unstructured data, Challenges of big data, Big data analytics, Big data applications. Distributed File System, Hadoop Architecture, Hadoop Ecosystem, HDFS, HDFS Administering. Map Reduce Architecture and Programming, Spark, Spark APIs, Algorithms using MapReduce. Hive Architecture, HiveQL, HBase, Pig, Zookeeper, Applications with Zookeeper. Big Data Algorithms and Techniques, Interactive Data Analysis and Visualization, Sentiment Analysis.

CSL536 Intrusion Detection and Prevention System
(2-0-2) 3 credits
Understanding Intrusion Detection, IDS and IPS analysis schemes, Attacks, Detection approaches, theoretical foundations of detection, intrusion detection, reaction and architectures, legal issues and organizations standards, applications and tools,Tool Selection and Acquisition Process.

CSL537 Risk Management Policies and Principles
(2-0-2) 3 credits
Introduction to risks and their management, Pre and post-loss risk management, Responsibility of risk management, Objective of risk management, risk management policy, Authorization and Authentication, risk management process, security metric, Requirement for Security Metrics, risk assessment, Security threat correlation, information system audit, Foundations of information Systems Auditing, IDS, Log Files, Honey Pots.

CSL538 Secure Coding and Software Vulnerability Analysis Lab
(2-0-2) 3 credits
Introduction to secure coding, types of security vulnerabilities, Buffer Overflows, Unvalidated Input Race Conditions, Inter process Communication, Insecure File Operations, Access Control Problems Secure Storage and Encryption. Avoiding buffer overflows and underflows, validating input and inter process communication, race conditions and secure file operations, elevating privileges safely, designing secure user interfaces, designing secure helpers and daemons, avoiding injection attacks and xss, security development checklists, third-party software security guidelines.

CSL539 Digital Forensics
(2-0-2) 3 credits
Context, Legal and Practical Considerations Cybercrime; Forensic process; computer forensics, Investigative tools (Open Source and Proprietary); Email & Browsers, network forensics: Attack trace-back; Packet inspection; Log analysis, Hashing issues; Anti-forensics (encryption and stealth techniques), digital forensics, laws and acts.

CSL541 Security in Distributed System
(2-0-2) 3 credits
Distributed Systems, Architecture of Distributed systems, Message passing systems, distributed file systems. Systems modelling, clustering and virtualization, hostlevel threats and vulnerabilities, application-level threats and vulnerabilities, Application-Layer Vulnerabilities, Injection Vulnerabilities - Cross-Site Scripting (XSS) - Improper Session Management - Improper Error Handling - Improper Use of Cryptography - Insecure Configuration Issues - Denial of Service - Canonical Representation Flaws - Overflow Issues. Service-Level Threats and Vulnerabilities: SOA and Role of Standards - Service-Level Security Requirements

CSL542 Reverse Engineering and Malware Analysis
(2-0-2) 3 credits
Understanding the terminologies related to reengineering, forward engineering, and reverse engineering; security-related reverse engineering, advanced reverse-engineering, malware analysis, Fundamental aspects of malware analysis, techniques for malware analysis, malware analysis in different environments.

CSL543 Cyber Security
(2-0-2) 3 Credits
Pre-requisites in information and network securityOverview of Networking Concepts, Information Security Concepts , Security Threats and Vulnerabilities , Cryptography / Encryption, Security Management - Security Management Practices ,Security Laws and Standards Information and network security - Access Control and Intrusion Detection, Server Management and Firewalls , Security for VPN and Next Generation Technologies, System and Application security - Security Architectures and Models , System Security, OS Security, Wireless Network and Security. Digital forensics, evidence and intelligence- operating system and file system analysis. Understanding file systems, data collection from popular operating systems such as Windows, Incident response procedures, crime scene management, recording of evidence and reporting of investigations. Understanding national and international digital forensic investigation infrastructures and the agencies involved in cybercrime investigation.

CSL551 Foundations of Data Science
(2-0-2) 3 Credits
Understanding data and exploratory data analysis- problem definition, appropriate data sets, preprocessing of data, cleaning, integration, transformation, feature reduction; data summarization, statistical inferences about data- probability distributions, difference between causation and correlation; hypothesis testing, p-value testing, confidence intervals, foundation of

data modeling- multivariate regression, collinearity and covariance matrix. evaluation of models, model fit using loss functions, RMS error, ANOVA, MANOVA, entropy, information criterions, data visualization, visualizing spatio temporal data , content and surface plot, high dimensional data parallel, state coordinates, charnoff faces.

CSL552 Cloud Computing
(2-0-2) 3 Credits

Introduction to Virtualization, Binary Translation, Hardware Virtualization, Memory Resource Management in Virtual Machine Monitor, Software Defined Storage (SDS), Software Defined Networks (SDN) and Network Virtualisation, Data Centre Design and interconnection Networks, Cloud Architectures, Public Cloud Platforms (Google App Engine, AWS, Azure), Cloud Security and Trust Management, Open Source Clouds (Baadal, Open Stack, Cloud Stack), Cloud Programming and Software Environments (Hadoop, GFS, Map Reduce, NoSQL systems, Big Table, HBase, Libvirt, OpenVswitch), Amazon (Iaas), Azure(PaaS), GAE (PaaS).

CSL553 Analytical Databases
(2-0-2) 3 Credits

Overview of DBMS concepts, OLTP vs OLAP, Data warehousing, Operations in data warehouse, Schema design, Data warehouse architecture, Query Processing, evaluation and heuristics in query optimization, Different types of data, Non Relational or NoSQL databases, various categories of NOSQL databases, Brewer's CAP theorem, MongoDB, Neo4J, Distributed Data Processing and Data Security.

CSL554 Text and Web Intelligence Analytics
(2- 0- 2) 3 Credits

Pre-processing-tokenization using n-gram, vector creation techniques and Zip's law, stop word removal, stemming, part of speech; Text Categorization- supervised text categorization algorithms - Naïve Bayes, K-NN, SVM, ANN and ensemble methods, Logistic regression; Text clustering, visualization and topic modeling- identifying the clustering structure of a corpus of text documents using connectivity based clustering and centroid-based clustering. Uncovering hidden thematic structures, visualizations; Sentiment analysis- sentiment polarity prediction, review mining; Web Mining process and techniques- data collection, web scraping, leveraging site content and structure, user tracking and profiling, Privacy issues.

CSL555 Machine Learning for Data Science
(2 -0- 2) 3 Credits

Introduction to Machine Learning, Applications of machine learning, Linear regression models, Multiple Linear Regression, Support Vector Regression, VC Dimensions, PAC Learning, Model Selection and Generalization, Support Vector Machines, Neural Networks, Performance Measures, Hierarchical Clustering, Partitioned based clustering, Density based Clustering, Subspace based Clustering, Applications of clustering, Introduction to Learning Models, Bayesian Models, Gaussian Models, Markov Models, Continuous State Markov Models, Hidden Markov Models, Feed forward deep networks, Deep recurrent networks.

CSL557 Social Media Analytics
(2 -0- 2) 3 Credits

Introduction to Social Media Mining, sentiment analysis, Challenges for Mining social media, Graph and Network Models; Communities and interactions, Community detection, community evolution, community evaluation; Information Diffusion in Social Media: Herd behaviour, information cascades, epidemics; Applications of social media: influence and homophily, distinguishing homophily and influence; Recommendations in social media, recommendation algorithms, evaluating recommendations, behaviour analytics, individual behaviour and collective behaviour; Mining Twitter Data: graph visualization of tweets, tweets API, cliques and geodata.

CSL613 Applied Cryptography
(3-0-2) 4 Credits

Crypto design and analysis from classical systems, block ciphers (Feistel, DES, Triple DES, AES and modes); Stream Ciphers (Introduction, RC4, A5/1) and Public Key Crypto-Introduction(Knapsack, RSA, Diffie-Hellman, El Gamal), Use of Public Key Crypto for Confidentiality, Signature & Non repudiation, PKI, Hash Functions (Birthday Problem, Non cryptographic Hash, HMAC), Uses of Hash Functions and Digital Signatures. Basic

Concepts of risk, threats, vulnerabilities, and attacks, Authentication Methods and authorization (Access Control matrix, access control, Multilevel & Multilateral Security).Firewalls, Intrusion Detection-Signature-based & Anomaly-Based IDS, Real-World Security Protocols(Introduction, SSL, IPSec, Kerberos), GSM-Secure Architecture, Authentication Protocols, Security Flaws,3GPP.Software Based Attacks, Insecurity in Software-Introduction, Software Reverse Engineering, Software Tamper Resistance, DRM, Finding Flaws, Operating System Security Functions, Trusted Operating Systems-MAC, Trusted Path, Trusted Computing Base, NextGeneration Secure Computing Base.

Bachelor of Technology in Computer Science and Engineering
Department of Computer Science and Engineering

DEPARTMENT CORE SUBJECTS

CSL106 FOCP-I
(2-0-4) 4 Credits
An Overview of Computers and Number Systems, Computer Networks, basic architecture and topologies, Types of Programming languages, Pseudocodes, Flowcharts, Assembler, Compiler, Interpreter, Linker, and Loader, An Overview of C, Loops in C, Functions, Pointers, Arrays, Strings in C, Structures, File management in C.

CSL110 Problem Solving and Design Thinking
(2-0-2) 3 Credits
Meet Design Thinking, Stimulating the mind from different angles, In and Out of Box Thinking Mastering the art of critical, Experimentation with mapping tools, creating personas, Design thinking principles, Creating Storyboards, Preparing the mind for innovation and generating ideas.

CSL108 FOCP-II
(2-0-4)4 Credits
Object oriented Programming Concepts: Programming Paradigms: Procedural, Object oriented, Functional, Features of Java 8, JDK, JRE and JVM, Classes , Objects, Methods, Primitive and Reference Variables, Operators and Controlling Constructs, Enums, Methods and Constructors, Arrays and array of objects, Polymorphism, Inheritance and Interfaces , Packages, The Java Library: Java. lang, java.io, java. util, java. util. stream, java. util. concurrent, java. Nio , Exception Handling, Multithreaded Programming, String Handling , Input Output, The Collections Framework ,Lambda expressions, Junit.

CSL209 Data Structures
(3-0-2) 4 Credits
Data Structures Introduction, Types of data structures, Linear and Non-linear data structures, Array traversal, Linear and Binary search, Linked list introduction, Insertion and Deletion, Doubly Linked list, Circular Linked list, Stack operations, Polish Notations, Introduction to Queues, Circular Queues, Doubly ended queues (Dqueues), Priority Queues, Introduction to Binary Trees, Expression trees, Tree traversal: Inorder, Preorder & Postorder, AVL Trees, Insertion and Deletion, B Trees, Introduction to Graphs, Representation, Graph traversal: Breadth First Search & Depth First Search, Sorting Algorithms, File Organization: File representation on hard disks, Indexing and Hashing techniques, Linear probing & Quadratic probing.

CSL240 Computer Networks
(3-0-2) 4 Credits
Physical layer, Datalink layer, Network Layer, Transport Layer, Application Layer, Software Defined Networks, Need for SDN, Architectural components, Control and Data Plane Separation, Applications. IoT Network - Framework, Enabling Technologies, IoT Gateways and Protocols. Cloud based Networks- Virtualization, Virtual Private Cloud, Storage Area Network, Network Attached Storage.

CSL223 Web Development Technologies
(2-0-4) 4 Credits
Introduction to Web Applications, HTML Basics, Syntax, Overview, HTML 4 forms, HTML5 Syntax, HTML 5 Events, attributes, Web forms 2.0, CSS3 (Presentation & Styling), Borders, CSS3 Backgrounds, CSS3 Text Effects, CSS3 Fonts, CSS3 2D Transforms, CSS3 3D Transforms, CSS3 Transitions, CSS3 Animations, Bootstrap, Bootstrap Grid System, Grid options, Bootstrap CSS Overview, Bootstrap Typography, Bootstrap Tables, cards, Bootstrap Forms, buttons, Bootstrap Responsive utilities, DOM, Variable declaration, Operators, Control Statements, Error Handling, Understanding arrays, functional programming, Variable declaration, Operators, Control Statements, Error Handling, Understanding arrays, functional programming, Built in functions,

Database connectivity, cookies, Introduction to MVC Framework, CRUP App.

CSL422 Cyber Security
(3-0-2) 4 Credits
Data, Information, Security Triangle, key terms, Types of Information, Cyber Terrorism, Defacement, Cyber laws, Network Terminologies, Introduction to Malwares, Information gathering, Web VAPT, Network VAPT, IMSM, Information gathering Domain Name Services, targeting email and Maltego, digital footprinting, Nmap and Port Scanning, Vulnerability Scanner, OS Fingerprinting, Banner Grabbing, Enumeration Tools, Vulnerabilities and levels of vulnerabilities, Penetration testing OS, Wordlist generator, Crunch tool, Direct Exploitation, Password Attacks-Online Offline, Exploitation-Client-side Attack, Social Engineering exploitation, OS login bypass, online, offline method, Keyloggers (Ardamax), Malwares, Trojan, Dark comet, Remote Connections, Post exploitation, Power-hub tool File Transfer Without interactive Shell, Exploit Development, Pivoting, setting up domain controller.

CSL214 Database Management Systems
(3-0-2)4 Credits
Introduction, Overview of Database Management Systems Database Architecture , Relational Model Concepts, Relational Database Design , Functional dependencies, Normal Forms , Normalization, Query Languages , Procedural: Relational Algebra , Non-procedural: SQL, Relational Calculus, Query Optimization, Conceptual Database Design , ER Model, EER Model , ER and EER to Relational Model Transaction Management & Concurrency Control Transaction Processing Concurrency Control Mechanisms, Database recovery Techniques, Introduction to NoSQL (MongoDB), Overview, Document Data Model, MongoDB Query Language.

CSL303 Operating System
(3-0-2)4
Introduction to Operating System-Evolution of OS, Design goals, System Calls, OS Services Process – scheduling, Process State Diagram, Scheduling Algorithms, Threads, Process Synchronization, Software Solutions, Hardware Solutions, OS Type Solutions. Deadlocks Handling, Characterization, Prevention, Avoidance & Prevention, Memory Management, Paging, Segmentation, Virtual Memory, File & Device Management, File Systems, Disk Management, Case Studies - Microsoft family of OSs, Linux OS.

CSL236 Introduction to Artificial Intelligence & Machine Learning
(3-0-2)4 Credits
Introduction to artificial intelligence, Overview of machine learning, techniques in machine learning, deep learning, differences between deep learning, machine learning and AI, Data Preprocessing, data cleaning, data transformation: standardization and normalization, data smoothing, dimensionality reduction, different encoding schemes for categorical and numerical features, Regression Techniques , K Nearest Neighbors, Support Vector Machine, Kernel SVM, Naïve Bayes, Decision Trees Classification, Random Forest Classification, Overfitting, Underfitting, Bias and Variance model, Bootstrapping, Cross-Validation and Resampling Methods, Performance Measures: Confusion matrix, ROC.

CSL236 AI for Games
(3-0-2)4 Credits
Introduction to AI in games, vector mathematics in games, creating a character using vectors, making character travel to a specific goal location, animating character while moving, slerping, animation, translation and introduction to waypoints, Unity's waypoint system, Introduction to Unity's vehicle system and customizing care behaviors, graph theory and pathfinding, Implementing pathfinding-using waypoints, navmeshes, Implement a player follow system using navmeshes and set up off mesh links, crowd simulation and create a crowded city, line of sight and finite state machines, Convert finite state machines to work on a nav mesh, Behavior trees and nodes, Goal Oriented Action Planning.

CSL230 Analysis and Design of Algorithms
(3-0-2) 4 Credits

Introduction and foundations :Role of algorithms in computing, Algorithms as technology, analyzing and designing algorithms, Growth of Functions, Asymptotic notations, Recurrences, Substitution method, Recursion tree method, Master method ,Divide and Conquer :General method, binary search, merge sort, quick sort, selection sort, heap sort, Strassen's matrix multiplication algorithms and analysis of algorithms for these problems. Greedy Method: General method, knapsack problem, job sequencing with deadlines, minimum spanning trees (Kruskal's Algorithm, Prim's Algorithm), Shortest path algorithm (Dijkstra's Algorithm, All pair shortest path) and analysis of these problems. BFS, DFS, Activity selection problem Dynamic Programming: General method, Principle of optimality, 0/1- knapsack, the traveling salesperson problem, Optical binary search tree. Backtracking: General method, 8-queen's problem, subset sum problem, Graph Coloring, Hamiltonian cycles, analysis of these problems, Branch-and Bound: Introduction to Branch and Bound, LC search and FIFO search, 0/1- knapsack and traveling salesperson problem, efficiency considerations, NP and NP complete: Basic concepts, Cook's theorem, NP hard graph and NP scheduling problems some simplified NP hard problems.

CSL229 Software Engineering and Project Management
(3-0-2) 4 Credits

Software practices, Process models and Agile Practices, SDLC, Process models: Linear, Spiral, Unified etc. ,Agile Process model, Extreme Programming , Scrum, Requirement analysis, Design process, Coupling, Cohesion, Structured analysis, Structured Design, Data flow design, Object Modelling using UML, Unit testing, Black box testing, White box testing, Integration testing, System testing, Stress testing, Regression testing, Project monitoring, Risk management, Six Sigma, Resource allocation, Project evaluation and estimation, Software metrics, Metrics for project size estimation: COCOMO and Function point analysis

CSL318 Theory of Computation
(3-0-2) 4 Credits

Regular Languages, Finite Automata, equivalence, minimization, Myhill-Nerode Theorem, introduction to nondeterminism, Context free grammars, Pushdown automata, equivalence and applications. Turing machines, Recursive and Recursively enumerable sets, non-determinism, RAMs and equivalence, Universal Turing Machines, undecidability, Rice's theorems for RE sets, Post machines, Basics of Recursive function theory. Equivalence, Church's thesis, computational complexity, space and time complexity of Turing Machines, Relationships, Savage's theorem, complexity classes, Complete problems, NP-completeness, Cook-Levin theorem..

CSR118,119,218,219,318,319,418 General Proficiency
1 Credit each (0-1-0)

General proficiency evaluation is conducted in the 8th semester where a student will be evaluated for his achievements and participation in extra-curricular activities throughout four years and also for his academic excellence. The evaluation is based on academic performance, co-curricular activities in sports, cultural fest etc., social outreach, general awareness, soft skill development and outstanding achievements.

CSD401 Major Project (A)
4 Credits

Development of a technical project, research and simulation or hardware implementation of new or recent technological trend under the guidance of faculty. Complete literature survey, feasibility testing, circuit design, component arrangement etc.

CSD402 Major Project (B)/Internship
6 Credits

Completion of Project with good hardware which has Financial Viability ,Originality-innovativeness, Customer end applicability, Usefulness to society- addressing a larger

section, Sustainability or simulation results with good research paper and report of complete project with appropriate results and conclusions undertaken as ECD405.

A full 14 week internship can be done in lieu of major project part B which has to be approved prior to start and evaluated after completion.

CSC301 Seminar
1 Credit (0-1-0)

Independent study on any latest trend in communication technology or any recent research field. Students are evaluated on individual basis on the parameters like content of the topic, delivery, presentation techniques and viva-voce.

CST208 Industrial Training
2 Credits

Better interaction between Technical institutions and industry is of the essential today. At the end of semester 4, Students are sent to industries of interest areas for 4-6 weeks to have hands on experience and exposure to industrial environment. This is continuously monitored by internal faculty supplemented by a compulsory visit of faculty to company for feedback. At the end of the training the students are evaluated.

CST308 Industrial Training
3 Credits

Exposure to the industrial atmosphere and subsequent placement of young graduating engineers in industries across the country is of the essential today. At the end of semester 6, students are sent to industries of interest areas for 6-8 weeks to have hands on experience and exposure to industrial environment. The students are exposed to the professional environment and learn the technical and behavioral skills. They are continuously monitored by internal faculty supplemented by a visit to the company by the same faculty during their training. At the end of training they are evaluated.

CSV201 Skill Development
(1-0-2) 2 Credit
(Python to be taught to Cyber Security & Forensics, Blockchain and Full Stack specializations)
Python concepts, expressions, values, types, variable, programs & algorithms, control flow, file I/O, the python execution model, list, set, dictionary (mapping), tuple, graph (from a third party library). List slicing (sublists), list comprehension (shorthand for a loop). Mutable and immutable data structures. Distinctions between identity and (abstract) value, procedural abstraction, function as values, recursion and function design methodology. Data abstraction, modules, objects.

(Web Development to be taught to Cloud Computing, Data Science and AI&ML specializations)
HTML4 and HTML5 tags, CSS2, CSS3, selectors, advanced selectors, input data validation, animation, flex box, box model, Bootstrap, internet resources, JavaScript basics, variable, control structures, operators, DOM and MVC framework.

(Adobe Photoshop to be taught to GameTech, AR and VR specialization)
Photoshop's interface, crop and resize images, work with color to edit and manipulate images, combine aspects of several images into one professional images, work with layers, paint using Photoshop's many tools, add text to images, create and use gradients, remove objects from images without leaving an empty space, making it look like the image was edited, select objects easier and better way, use of filters to manipulate the look and feel of images.

CLP 310 Campus to Corporate
(0-0-2) 1 Credit
Difference between CV/ Resume / Bio data; Importance of a professional resume; Writing objectives; Cover letter; Resume writing layout; Verbal skills; Reasoning; Perceptual speed & accuracy; Handle analytical questions ; Understanding group discussion; Kinds of group discussion; Techniques to handle group discussion; Case study group

discussion; Mock Group discussions; Importance of grooming; Powerful dressing for men and women; Body language postures and gestures; Understanding interview process; Types of interview; Handling case study interview; Do's and Don'ts in an interview; Interview cracking techniques; Frequently asked questions in the interview; Myers–Briggs Type Indicator (MBTI); Practice and rehearsals with feedback.

SEG400 GATE
0 Credits –Audit Course
Preparation and test of National GATE examination. The scores of GATE test will be mapped to the marks scheme of NCU and an internal qualifying test will be used for credit calculation.

PROGRAM ELECTIVE COURSES

B. Tech. CSE scheme
Specialization: Game Tech. AR, VR

CSL243 Game Design and Asset Creation

This is course students will learn to create 2D and 3D assets essentials for game development with introduction of the skills required to create 3D Models in Industry Standard 3D Software efficiently. Students will learn different methods of modelling and texturing, and how to achieve good topology in a 3D model. Students will have the ability to develop, discuss, and implement from preproduction, to production, Assets for video game Industry. Students will have the skills to model, articulate, and render game requirement. Students will learn professional terms relating to real-time game asset creation. Produce professional game model renderings and breakdowns for use in a portfolio. Be familiar with time management as per professional asset development pipelines. This module will also give a theoretical and conceptual understanding of the field of game design, along with practical exposure to the process of creating a game and understand what defines a "game" and the mechanics and rules behind different types of games. Topics covered include iteration, rapid prototyping, mechanics, dynamics, flow theory, the nature of fun, game balance, and user interface design. Primary focus is on non-digital games. By end of the module, students will be creating a physical board game as their final project.

CSL245 Programming for Games

This is an introductory course for students will learn how to program by creating your very own games using Unity3D, an industry-standard program used by many large gaming studios and indie developers across the world and Master basic game development (produce, test and present a beta version of a game of your own design). Understand game design and apply the concepts for game development. Students will also learn most common languages for game designers to learn are C++ and C# for unity will be able to operate and write Unity based C# program with Production Work Flow - 3Ds Max to Unity. By the end of the module, students will create a 2D platformer game.

CSL236 Artificial Intelligence for Games

Artificial intelligence (AI) is used to generate responsive, adaptive or intelligent behaviors primarily in non-player characters (NPCs) similar to human-like intelligence.

In this course, for Game students will understand how to decide which move to take based on future possibilities and payoffs (just as, in chess, we look n-moves ahead into the future).Learn how to solve applications where there are a number of parameters to optimize, such as time or distance, and the possibilities are exponential and also how to design the various stage of the evolutionary algorithm that will control performance.

Topics will go through different simulated 'thinking' agent development features and paradigms. Different 'brain' design will be discussed in this module such as FSM, fuzzy logic, and weighted behaviour tree to achieve relatable and believable autonomous agents in games.

CSL244 Advance Programming for games

This Module introduces students to more advanced concepts in game design and development such as concept ideation, digital prototyping, Develop Games (3D), interface design, usability testing, communication, project scoping and management. Student will learn advanced game programming techniques, utilize industry-standard technologies, and apply your programming skills to animation, artificial intelligence and multiplayer systems. student will independently Identify, choose, and implement appropriate algorithmic, programming, and mathematical techniques to develop software components for various aspects of computer games, such as character control, scene management, artificial intelligence, graphics and animation. Create prototype games or game fragments by integrating original software components with existing professional tools, such as game engines, middleware, and common application programming interfaces also Test, debug, and optimize a game or game component to meet production requirements.

CSL343 Designing Human Computer Interfaces
Human Computer Interaction (HCI) is a multidisciplinary area concerned with the design, evaluation. This course teaches students to design user interfaces based on the capabilities of computer technology and the needs of human factors. Students design a user interface for a system and implement a prototype from a list of informal requirements. In this course students design projects that are developed by current human–computer interaction principles and understand the User Centre Design (UDC) ,Graphic User Interface (GUI)Design &Aesthetics by Creating a prototype of HCI by end of the course.

CSL246 Cross Platform Game Development
In this course, students will learn the best practices and techniques, to build, publish, and maintain your games. Here students will take their game development skills to the next level by deploying your games to different cross platform like – Android, iOS, Xbox and PS4.It is necessary for games to be developed for use across multiple platforms that operate on various networks and operating systems. This course provides practical and relevant skills to allow graduates to be proficient in cross-platform game development aspects such as their tools and programming languages. Graduates will have a deeper understanding of best practices and methods to develop games for a wider set of users. Students will master with a game that can be instantly published and played on multiple platforms.

CSL341 Augmented Reality Development
Augmented reality [AR] is poised to revolutionize the way we understand the world by overlaying physical reality with real-time, interactive virtual content. AR will completely change the way users understand the world and their digital experience. AR will overlay the real world with games, adds, knowledge and much more. This course covers the concepts of Augmented Reality, equips graduates with the practical skills to develop games/applications using this emerging technology, and will break down complex AR concepts to make them easy to understand.

Students will start with the fundamentals of augmented reality (AR), and how to build an AR experience using ARCore. Will also learn how to develop their own mobile AR applications in Unity for iOS and Android devices and about the features offered by Unity's AR Foundation, and about additional features in ARKit and ARCore. Using the very latest techniques recommended by Unity, Students would build a complete AR environment that you can continue to use after the course, while learning to apply best practices in user experience and interaction.

CSL345 Virtual Reality Development
Technology is rapidly changing and evolving, with virtual reality (VR) being one of the most popular tech trends today. This course covers the concepts of VR and equips graduates with the practical skills to develop games/applications using this emerging technology. With this new knowledge, graduates will be able to analyse, design, plan, and create game/applications that leverage VR technologies along with VR students will also cultivate the skills to design, program and develop Interactive experiences using Mixed Reality software and hardware. Students will learn the fundamental concepts and applications of mixed reality using a modern game engine and hardware platform. Students will also learn to appreciate the unique design opportunities inherent to the platform. To supplement and simulate the physical world, students will learn methods and practices to meaningfully integrate virtual content into physical world.

B. Tech. CSE scheme Specialization: Full Stack

CSL371 Mobile Application
Introduction to flutter, Understanding flutter Architecture, Dart Basics: Installation, First program in Dart, Data types in Dart: Number, String, Boolean, List, Set, Map; Dart - Const and Final Keywords ; Control Flow Statements: if else, switch case, conditional operators, loop, Labelled loop, Break and Continue, Functions in Dart: Functions, Fat Arrow Functions, Optional

Positional Parameters, Optional Named Parameters, Functional Programming, var args, Anonymous function, future and Async, Server call, Map & key –value pair, List, Set, Object Oriented Programming in Dart: Class and Object, named constructor, Setters & getters , Is –A , Abstract Class, Interface, import, Down casting; Exception handling, Flutter Versions, Flutter architecture, Flutter Future, Flutter MAC and window Setup (Installation of Android Studio), Material Design in Flutter, Building and Understanding First Project , Running the First Project (Android Emulator and IOS Emulator), Widget basics , Types of Widgets, Hello World App with Variable value, Writing Scaffold , AppBar, Adding Row and Column Layout and its Properties, Button Event Binding with function and anonymous function, Stateless v/s Stateful widget, Writing EMI App (TextField, Controller, CallBack) Connect Mobile and Test on Mobile, Debugging: Break Points and Logs, Dart Dev Tools. Core Flutter widgets: Scrollable Row and Column, Button and types, ListView, ListTile, Future, Builder , Http Call , Life Cycle GridView, GridTile, AppBar Buttons ,Floating Action Buttons, Modal Bottom Sheet, Themes and Text Styling, Custom Fonts, SizedBox, Routing, Tabs, Drawers, Filters, State management using provider, Connect with FireBase, Login with Gmail, Camera, GPS Access.

CSL373 DevOps
Introduction to DevOps, Agile, Continuous Integration, Continuous Delivery and the Three Ways; Principles of Flow, Principles of Feedback and The Principles of Continual Learning and Experimentation, Continuous Deployment, DevOps Practices, Relationship between Agile and DevOps, Differences between DevOps and Traditional approach, Overview of DevOps tools, Categories of DevOps tools, CI/CD Pipeline, Operational Methodologies: ITIL, COBIT, System Methodologies: LEAN, Maven Introduction, Features of Maven in DevOps, Installation and working of Maven, Core concepts of Maven, Maven Repositories, Maven Architecture, Pros and Cons of Maven, Project Object Model, Build Life-Cycle, Build Profiles, Creating Project using Maven, Build and Test Project, Repositories and

Plug-ins, Docker Overview, Benefits and Use of Docker, Installation and Configuration, Running the first container, Working with Containers, Docker Hub, Images: Docker Image Basics, Building our own image, Pushing images to Docker Hub, Docker Architecture, Docker Engine, Docker Networking Basics, Testing with Docker: Using Docker to test a Static Website, Kubernetes Basics, why use Kubernetes, Features and Architecture, Installation and Setup, Images, Jobs, Labels and Selectors, Namespace, Node, Service, Pod, creating a Kubernetes Cluster, Deploy an app, Overview and Installation of Jenkins, Preparing Environment and Setting up Jenkins, creating a new job with Jenkins, Running Jenkins job, Configuring Tools and Jenkins Server, Configuration of build tools with Jenkins, Build Job, Testing.

CSL273 Enterprise Web Applications
Collections Framework: An overview, Benefits of using different collections classes, ArrayList: Introduction, Syntax, Usage examples, Sorting & Comparison, LinkedList: Introducing LinkedList class, Inserting and Deleting a new node, Iterator Interface, Sets: Introduction to Set Interface, HashSet and TreeSet, Examples and Usages, Maps: Introduction, HashMap and TreeMap, Examples and Usages, Stack: Introduction, Example and Usages, Queues: Introduction, Example and Usages, Priority Queue, Comparable & Comparators, Applications, Pros and Cons Generics Introduction: Why Generics, Examples and syntax, Generic Class: Declaration and Example, Generic Methods: Declaration and Example, Generic Interfaces: Declaration and Example, Comparing Generics Objects, Inheritance Rules for Generics, Bounded Type Parameters: What it is?, Example Pseudocode, Wildcard Arguments: Definition and usage Examples, Generic Constructors, Generic Interfaces, Generic Limitations, Multi-Threading Fundamentals: Introduction and Example Usages, Thread States and Transitions, Creating Threads - Using Thread class, Using Runnable Interfaces, Starting a Thread, Joining Threads: using Join Method, Thread Priorities: Example Demonstration, Synchronization: Concept and Example, Inter-Thread Communication: wait(),

notify() and notifyAll(),Introduction to JDBC: Components, Architecture, JDBC API, Establishing a connection, JDBC Demo (Connection with a relational database), Drivers, Statements, PreparedStatement, Exploring ResultSet, BLOBs, CLOBs, Metadata, Transaction Management, Exceptions in JDBC, Java EE, Different types of JEE Architecture, Introduction to MVC Architecture, Introduction to Apache Maven, Setting up Maven, Maven Repository – Local, Central, Remote Archetypes and pom.xml, Project Dependencies, External Dependencies, Snapshot dependencies, Plugins with the Maven Compiler Plugin, Creating a Maven Project in Eclipse, Maven Build Lifecycle, Phases, and Goals, Mvn commands

Introduction to Servlet API, Structure of web application, Request and Response Model: Get Vs Post, Servlet Container: How the container handles a request, Servlet Lifecycle, Environment Setup: Tomcat Installation, Deploying Web Applications: Working Example, Session Tracking/Management: Cookies, Hidden Form Fields, URL Rewriting, Http Session Interface, Session tracking in Servlets, Introduction to JSP, JSP lifecycle: Example, JSP Scripting Elements, Implicit Objects, Action Elements, Using Expression Language, JSP declarations, Developing JSP applications, Tags in JSP, Working with JSTL tags, Custom Tags in JSP, Handling JSP Errors, JSP Session Management, Software Testing Introduction, Why Unit Testing is important, Introduction to Junit, Overview of Junit: Installation Steps, Junit 5 Architecture, Environment setup, Creating Test Cases, Introduction to Mockito Framework, Overview of Mockito and mock objects, Using Mockito API, Adding Mockito to a project, Throwing Exceptions, Logging: What is logging, Introduction to SLJ4, Environment Setup, When and how to use SL4J, Parameterized Logging, SL4J Profiler.

CSL374 Micro service Based Application
Micro services, Value Proposition, Distributed architecture, Service oriented architecture, Business oriented, Design for failure, Decentralized data management, Discoverability, Inter-service communication, REST API,

Boundaries, API Design, Decomposing Monolithic applications, Independent Deployment, Docker and Micro services, Micro services Security, Micro services testing, Reference architecture, event driven architecture, Micro services and DevOps., Deployment and testing of web services.,

CSL276 NoSQL Databases
What is NoSQL, Why NoSQL, List of NoSQL databases, Characteristics of NoSQL, Storage Types in NoSQL (Column oriented, Document store, Key-value store, Graph store, Multi storage type databases, Advantages and drawbacks of NoSQL databases, Introduction to Mongo DB, Installation and Setup, Basic Data Types, Using MongoDB shell, running a script in MongoDB, Data Modelling and Architecture, Advantages of MongoDB - Why & Where to use, Introduction to Mongo DB, Installation and Setup, Basic Data Types, Using MongoDB shell, running a script in MongoDB, Data Modelling and Architecture, Advantages of MongoDB - Why & Where to use, General concepts of Aggregation & Sharding, Pipeline Operations($match, $project, $group, $unwind, $sort, $limit, $skip), Map reduce and Aggregation commands, Introduction to sharding, Configuring sharding (When and How), Text search Features in MongoDB, Text Index, Text operator, Extract phrase, Term Exclusion and sorting, Full text search and partial search, MongoDB NodeJS drivers and other dependencies, Use MongoDB client to make a connection with MongoDB, MongoDB and Collections, CRUD operation(create, read, update, delete using MongoDB), What is graph, Data Relationships, Relational Vs. Graph Data Modeling, Graph Theory & Predictive Modeling, Basics of Graph Search Algorithm.

CSL253 Web Frameworks
Angular Introduction, Single Page Application, Angular-cli, Binding, Directives, Controllers, Services, DOM, Templates, Angular application architecture overview, Model View-View Model (MVVM)
Typescript Introduction: Benefits, Environment Setup, Examples, Data Types and Variables: Basics, Arrays, Tuples, Enum and Void, Type

inference, Type Casting, Destructuring and Spread: Array destructuring, Objects destructuring, Mixed destructuring, Property renaming, Default values, Interfaces: Declaration and Initialization, Duck Typing, Excess Property check, Indexable Types, Extending Interfaces, Classes: Writing and Using classes, Constructor method, Inheritance, Type casting, Type assertion, Static Properties, Abstract Class, Modules, Functions, Events, Generics: Functions, Types, Interfaces, Classes, App structure understanding, how angular app executes (Flow of execution), Creating a new project, Project setting – bootstrapping, Building and Serving, Component based architecture, Angular Building blocks. Create first component using CLI, Selectors, Decorators, Directives, Model, Property and event binding, Life Cycle Hooks, Role of App Module and Component declaration, Registering Components, using multiple components and passing data, Understanding component selector, Create first service using angular CLI, inject service into a component, creating a Data Service, Understanding a Hierarchical injector, Instances of a Service, Injecting Services into Services, Using Services for cross component communication, How to make rest API call – HTTP Request and Response, Using REST data source, Making Cross Origin requests, Handling Errors. Routing Configuration, Routing Component, Adding Navigation links, Route parameters, navigating within a component, creating child routes, Guarding Routes, Loading feature modules dynamically, Targeting named outlets, Introduction to Express Framework, Introduction to Nodejs
, What is Nodejs, Getting Started with Express, and first Express App using JSON, Express Routing, and Implementing MVC in Express, Middleware, Using Template Engines, Error Handling, API Handling, Debugging, Developing Template Engines, Using Process Managers, and Security & deployment.

CSL274 Middleware Frameworks and ORM
What is Spring, Brief History of Spring, Why Spring, Before Spring (Loosely Typed Application Example), Basic Spring Example, what is IOC and DI, Spring vs J2EE, Understanding Spring

Framework in Detail, Understanding Various Factories in Spring. Spring Setup with JARS only, Spring Setup with Maven, What is Maven, Why we need it, About POM, About Dependency, About Goals, About Plugins, Spring XML Based Approach, Constructor, Injection, Setter Injection, Object Injection, Collection Injection, Bean Inheritance, Bean Life Cycle, Scopes: Singleton and Prototype, Application Context Aware, Code By Interface, Auto Wire and Its Types, Using Property File, Spring Annotation Based Approach, Stereotype, Auto Wire and it types and Qualifiers, Default Bean Name, Qualifiers with Constructors, Using Property file, Constructor Injection, Setter Injection, Object Injection, Collection Injection, Bean Inheritance, Bean Life Cycle, Scopes: Singleton and Prototype, Spring Java Config Approach:
@Bean, @Configurable, @Primary, Using Property file: Constructor Injection, Setter Injection, Object Injection, Collection Injection, Bean Inheritance, Bean Life Cycle, Scopes, Singleton and Prototype, Overview, Advice Types, Pointcuts, Ordering Aspects, Join Point, Overview, MVC Flow Understand, Setup Spring in Maven, Hello World in Spring, Request Params, Path Params
Login / Register / Profile View and edit, Using JSTL, Page Redirect, Session Handling, Validations (Predefine and Custom), I18N, Error Handling, Spring integration with JDBC, Spring integration with Logger, Spring Integration with Mail, Spring integration with JPA, ORM Basics, Hibernate vs JDBC, Setup with Maven

B. Tech. CSE scheme
Specialization: Data Science

CSL225 Programming for Data Science
Course Introduction: What is Data Science Environment Set-Up–Anaconda Jupyter Overview Core Programming Principles built-in data types, conditional constructs, looping constructs, logical expression, control statements, Fundament also of Python Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences, Strings,

Tuples, Lists and Class Definition, Constructors, Inheritance – Overloading, Text & Binary Files - Reading and Writing ,Python for Data Analysis, NumPy, Pandas - Matrices and Data, Frames, Visualization in Python, (Matplotlib, Seaborn Pandas Built-in Data Visualization Advanced Visualization in Python,Plotly and Cufflinks Geographical Plotting.

CSL227 Applied Computational Statistics
Introduction to Classical (Frequentist) Statistics Types of Data (Quantitative, Qualitative, Logical), Exploratory Data Analysis (Histogram, Scatter plots, Box plots…), Fundamentals of Descriptive Statistics (moments- Measures of Central Tendency, Measure of spread, Measure of Shape), Markov Chains, LATEX, Probability and Combinatorics: Sample Statistics and Population Parameters, Events (Mutually Exclusive, Disjoints, Independent…), Counting Methods Permutations and Combinations), Joint, Conditional Probability, Bayes' Rule, Discrete Distributions Introduction, Probability Mass Function, Cumulative Distribution Function, Geometric Distribution, Binomial Distribution, Poisson Distribution, Continuous Distributions: Probability Density Functions, Cumulative Distribution Function, Inferential Statistics (Normal Distribution, Statistical Sampling, Central Limit Theorem), Estimations (Point and Intervals- Confidence intervals with means, sample, proportions) Hypothesis Testing :Introduction, Confidence Intervals, Critical Value based approach, P-value based approach, ZTests, TTests ,the $\chi2$ distribution, ANOVA/ANCOVA.

CSL232 Business Intelligence & Data Visualization
Introduction to Business Intelligence and BI Tools, Data Science with BITools, Data Visualization, Fundamentals, Evaluate the quality of data, visualizations and build high quality visualizations. Design Principles, Implement the best design practices, and to use the most appropriate chart for a particular situation, Creating Visualizations in Tableau ,Introduction to Tableau, Build data visualizations in Tableau., Use data hierarchies, filters, groups, sets, and calculated fields, Create map-based data visualizations in Tableau. Telling Stories with Tableau, Build interactive Tableau dashboards, Tell impactful stories using data. Advanced Data Mining With Tableau.

CSL234 Data Engineering
Data Preparation : ETL Phase 1 Data Wrangling before the Load, ETL Phase 2 Step-by-step guide to uploading data, Handling errors during ETL Phases 1 2, ETL Phase 3 Data Wrangling after the load, Handling errors during ETL Phase3, Data rangling Combining and Merging Data Sets, Reshaping and Pivoting, Data Transformation, String manipulation Regular Expressions (Regex),Data Aggregation, Group Operations, Time series Goup By Mechanics, Data Aggregation, Groupwise Operations and Transformations, Pivot Tables, Unstacking and Cross Tabulations, Date and Time Date Type tools, Time Series Basics, Data Ranges, Frequencies and Shifting. Association Rules - Apriori, FP Tree and Pincer Classification - ID3, C4.5.

CSL311 Big Data
Introduction to Big Data: Characteristics of big data, Big Data and its importance, Challenges of big data, Big data applications, Apache Hadoop and Hadoop Eco System-Storage, Hadoop Architecture, HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read Name Node, Secondary Name Node and Data Node, Hadoop Technologies – Cassandra, Map Reduce – Processing Big Data, Understanding Inputs and Outputs of Map Reduce, Elastic Map Reduce on Cloud, Hadoop Map Reduce paradigm Map and Reduce tasks, Cluster Setup ,Spark : Getting Started with Spark, Setting up Python with Spark, RDD, Functional Programming, Local Virtual Box Set-up, Amazon Web Service (AWS) EC2 PySpark Set-up, Databricks Setup (Optional), AWS EMR Cluster Setup, Running Spark on a Cluster, SparkSQL, Spark DataFrame Basics, Spark Graph X, Collaborative Filtering for Recommender Systems, Natural Language Processing in Spark, Real-time analytics with Spark Streaming, Big Data Analytics Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables,

Querying Data and User Defined Functions. Machine learning with big data, Spark MLib(Machine Learning Libraries – Classification and Clustering Algorithms).

CSL313 Machine Learning

Data Pre-processing and Vector Normalization for ML Clustering Algorithms, K Means, Hierarchical, Association Rule Learning, Apriori, Eclat,
Reinforcement Learning, Upper Confidence Bound UCB, Thompson Sampling, Unsupervised Learning
Hierarchical, DBSCan, Fuzzy C-Means, Dimensionality Reduction, Principal Component Analysis PCA, Linear Discriminant Analysis LDA, Kernel PCA, Model Selection , Model Selection, XGBoost , Feature Selection- Filter and Wrapper, Introduction to Self Organizing Maps, Building a Self Organizing Map.

CSL312 Deep Learning

Introduction to Deep Learning Introduction to ANN, Building an ANN, Evaluating, Improving and Tuning the ANN, Restricted , Boltzmann Machine ,CNN Introduction-Building a CNN, Evaluating, Improving and Tuning the CNN RNN Introduction - Building a RNN Evaluating, Improving and Tuning the RNN,LSTM , Boltzmann Machine Intuition, Building a , Boltzmann Machine, Auto Encoders Fundamentals Building an Auto Encoder, Types of Encoder, Deep Learning NLP Chat bots: Introduction to NLP (Natural Language Processing), Deep NLP Introduction, Building a ChatBot with Deep NLP.

CSL316 Introduction to Image Processing and Recognition

Elements of digital image processing, Image model, Sampling and quantization, Relationships between pixels, Image Transforms, Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform, Hadamard Transform, Image Enhancement, Enhancement by point processing, Spatial filtering, Enhancement in the frequency domain, Color Image Processing, Image Segmentation, Discontinuity detection, Edge linking and boundary detection, Thresholding,

Region oriented segmentation, Use of motion for segmentation Introduction to CV, Introduction to Face Detection, Face Detection with OpenCV, Object Detection Introduction, Object Detection with SSD, Generative Adversarial Networks (GANs) Introduction.

B. Tech. CSE scheme Specialization: Cyber Security

CSL283 Secure Coding and Vulnerabilities

This course deals with security architecture elements within modern object-oriented programming languages that create the framework for secure programming. This course would cover the design and implementation of secure systems. Coding Standards, best practices, guidelines and style will further enhance the ability to develop secure code. This course includes common software vulnerabilities and how to find them, as well as how the vulnerabilities can be exploited using reverse engineering & its tools. It also includes how buffer overflow attack happens and how attackers utilize it to gain access to the vulnerable system. Finally, at the end popular web SQL injection attack, and their common defense is implemented.

CSL281 Secure Communication and Cryptography

This course deals with the underlying principles of cryptography, an indispensable tool for protecting information in computer system. In this course, students will acquire knowledge on standard algorithms used to provide confidentiality, integrity, and authenticity. Starting from the classical ciphers to modern day ciphers, the course provides exposure regarding construction and cryptanalysis of symmetric key ciphers. It also covers stream cipher, public key ciphers, key exchange algorithm, one way functions, Message Authentication Codes (MAC) and signature schemes. Finally, it concludes with the design rationale of network protocols for key exchange.

CSL284 Digital Forensics and Malware Analysis

Digital forensics course plays very crucial role in investigating computer related crime. In this course, the different methods for the identification, investigation and analysis of digital evidences are examined. The course aims to present these concepts in a general setting that is not tied to one particular operating system. During this course, students will learn about core forensics procedures to ensure court admissibility of evidence. This course also includes the different methods for the identification, investigation and analysis of malicious code using various network and system-monitoring tools to examine and assess how malware interacts with the file system, registry, network and other processes in order to detect, analyze, understand, control, and eradicate malware. Further, the students will be able to utilize memory forensic techniques to examine, predict and compare capabilities of malware. It blends theoretical concepts with lots of real life examples and case studies to ensure practical exposure and through understanding all the digital forensics artifacts.

CSL387 Web and Mobile Security
This course offers you the knowledge and skills to build better and more secure web and mobile applications. It starts with importance of web security, working of web, strengths and weakness of web, factors that makes web vulnerable, and illustrates fundamental countermeasures that every web application should implement. Throughout the course, you will gain insights into the threats that modern web applications face and their countermeasures; not only in theory, but also in practice. Later on, this course focuses on various mobile threats and exploits. Particularly, this course emphasize on android applications as these applications are the biggest surface of attacks.

CSL384 Cloud Security Essentials
This course takes you on a tour of cloud computing systems and its security challenges. During this course, students will develop the necessary skills to identify possible security issues in the cloud environment. This course starts with basics of cloud, cloud security concepts covering encryption and presence of suspect in cloud, cloud security architecture and consequently discuss different

ways to secure a cloud. In this course, students will be able to: Understand important concepts of cloud computing such as types of cloud computing, deployment model, virtualization, etc. Design, implement and manage complete cloud computing systems. Identify security issues in cloud computing and different ways to store data safely on cloud.

CSL283 Network Security
This course delivers the technical knowledge, insight, and hands-on training students need to identify attacks on network with confidence. This course covers various aspects of network security including security issues in different layers of networks, intrusion detection, prevention and defense against cyber-attacks. Students will be guided through a series of laboratories and experiments in order to understand and analyze different attack/defend scenarios and determine the effectiveness of particular defense deployments against attacks

CSL385 Risk Analysis & Assessment
The goal of this course is to introduce a suite of risk analysis and assessment techniques to the students. It will assist students to develop an understanding of the fundamentals of risk management and to introduce classical as well as state-of-the-art risk analysis techniques. In this course, student will learn about risk management process, cyber risk exposures, cyber insurance, regulatory environment and how cyber risk management applies to the enterprise. Further, it covers risk assessment, mitigation and treatment of critical risk communication. At the end of this course, student will be able to identify information security related threats, vulnerability; Determine the risk level, define controls and safeguards and utilize a range of popular risk analysis techniques innovatively to examine risk problems

CSL382 Blockchain
This course introduces blockchain, a revolutionary technology that enables peer-to-peer transfer of digital assets without any intermediaries. It is designed to provide students with an understanding of key concepts and developments

around cryptocurrencies and distributed ledger systems. It develops a basic understanding of blockchain technology while covering basic properties of bitcoin, the mechanics behind it (e.g. including cryptographic hash functions, Bitcoin Script, privacy, and hash commitment schemes). It also demonstrates some of the blockchain use cases in technology, business and enterprise products. Other aspects of course include building a blockchain network and cryptocurrency and challenges in adoption of blockchain technology.

B. Tech. CSE scheme
Specialization: AI and ML

CSL225 Programming for Data Science

Course Introduction: What is Data Science Environment Set-Up–Anaconda Jupyter Overview Core Programming Principles built-in data types, conditional constructs, looping constructs, logical expression, control statements, Fundament also of Python Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences, Strings, Tuples, Lists and Class Definition, Constructors, Inheritance – Overloading, Text & Binary Files - Reading and Writing ,Python for Data Analysis, NumPy, Pandas - Matrices and Data, Frames, Visualization in Python, (Matplotlib, Seaborn Pandas Built-in Data Visualization Advanced Visualization in Python,Plotly and Cufflinks Geographical Plotting.

CSL227 Applied Computational Statistics

Introduction to Classical (Frequentist) Statistics Types of Data (Quantitative, Qualitative, Logical), Exploratory Data Analysis (Histogram, Scatter plots, Box plots…), Fundamentals of Descriptive Statistics (moments- Measures of Central Tendency, Measure of spread, Measure of Shape), Markov Chains, LATEX, Probability and Combinatorics: Sample Statistics and Population Parameters, Events (Mutually Exclusive, Disjoints, Independent…), Counting Methods Permutations and Combinations), Joint, Conditional Probability, Bayes' Rule, Discrete Distributions Introduction, Probability Mass Function, Cumulative Distribution Function,

Geometric Distribution, Binomial Distribution, Poisson Distribution, Continuous Distributions: Probability Density Functions, Cumulative Distribution Function, Inferential Statistics (Normal Distribution, Statistical Sampling, Central Limit Theorem), Estimations (Point and Intervals- Confidence intervals with means, sample, proportions), Hypothesis Testing :Introduction, Confidence Intervals, Critical Value based approach, P-value based approach, z-test, t-test ,the $\chi2$ distribution, ANOVA/ANCOVA.

CSL347 Applied Artificial Intelligence and Expert Systems

History of Artificial Intelligence, state-space, heuristic, depth-first, hill climbing, A, A*, AO*, stochastic, evolutionary search algorithms, Divide and Conquer, Greedy, Branch and Bound, Gradient Descent, minimax and alpha-beta search, Ontologies, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logic, standard logic, uncertainty, probability, probabilistic reasoning, probabilistic inference, baye's theorem, Bayesian reasoning, bayesian network, fuzzy sets, Semantic web, semantic networks, Architecture, Generation of expert system, Strip, K-strip, meta knowledge, domain expert, knowledge engineer, heuristics, expert system shells, Typical expert system such as MYCIN and DART.

CSL348 Reinforcement Learning

Overview of reinforcement learning: the agent environment framework, successes of reinforcement learning, Bandit problems and online learning, Prediction and Control by Dynamic Programing, Markov property, Markov chains, Markov reward process (MRP), Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations. Incremental Monte Carlo Methods for Model Free Prediction, Q-Learning and their variants. Function Approximation Methods, gradient descent, Gradient MC and Semi-gradient TD(0) algorithms, Control with function approximation, Least squares, Experience

replay in deep Q-Networks , Policy Gradients, Case studies

CSL349 Artificial Intelligence for Robotics

Introduction to Robotics: Progressive advancements, components, Degree of Freedom, Joints, Coordinates, Programing Modes, Robot characteristics, Robot Languages, Applications. Actuators, Sensors, signal conditioning, Kinematics of robots - Position analysis: Robot as Mechanism, Conventions, Matrix representation, Homogeneous Transformation, Representation of transformation, Inverse of Transformation, differential motions, Forward and Inverse Kinematic of Robots, Dynamic analysis of robot, Static force analysis of Robots. Robot Control System - Open and closed loop control, Linear control schemes. Partitioned PD control Schemes, PID control schemes, Force control of Robotics Manipulators tasks, Force control strategy. On-line and off-line programming, AI in Robotics, Applications in unmanned systems, defense, medical, industries, Machine Vision system.

CSL312 Deep Learning

Introduction to Deep Learning Introduction to ANN, Building an ANN, Evaluating, Improving and Tuning the ANN, Restricted , Boltzmann Machine ,CNN Introduction-Building a CNN, Evaluating, Improving and Tuning the CNN RNN Introduction - Building a RNN Evaluating, Improving and Tuning the RNN,LSTM , Boltzmann Machine Intuition, Building a , Boltzmann Machine, Auto Encoders Fundamentals Building an Auto Encoder, Types of Encoder, Deep Learning NLP Chat bots: Introduction to NLP (Natural Language Processing), Deep NLP Introduction, Building a ChatBot with Deep NLP.

CSL447 Computer Vision

Introduction and Image Sensing, Image Analysis pixels, Image Transforms, Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform, Hadamard Transform, Image Enhancement, Enhancement by point processing, Spatial filtering, Enhancement in the frequency domain, Color Image Processing, Image Segmentation, Morphological Filtering Discontinuity detection, Edge linking and boundary detection, Thresholding, Region oriented segmentation, Use of motion for segmentation, Affine Reconstruction Feature Extraction and Analysis, Pattern Calssification Introduction to CV, Introduction to Face Detection, Face Detection with OpenCV, Object Detection Introduction, Object Detection with SSD, Generative Adversarial Networks (GANs) Introduction.

CSL448 Computational Linguistics and Natural Language

Computers in Linguistics and Natural Language Processing, Syntax, Semantics, and Pragmatics, Applications of NLP, The role of machine learning, Brief history of the field, The nature and use of text corpora, Pattern matching using Regular Expressions, Corpus Search and Counting, Regular languages: N-grams, The role of language models, Simple N-gram models, Estimating parameters and smoothing, evaluating language models, Lexical syntax, Tokenization, Types of Tokenizers, Part-of-Speech Tagging, Stemming, Lemmatization, Stop-Word Removal. Grammar formalisms and treebanks, Context-free languages, Syntactic ambiguity, Context-free grammars, Push-down automata, Chomsky Hierarchy, Efficient parsing for context-free grammars (CFGs), dependency parsing, Chunking, Chinking. Lexical semantics and Word-Sense Disambiguation, Compositional semantics, Semantic Role Labeling and Semantic Parsing, Named Entity Recognition and relation extraction, Co-reference resolution, Feature Engineering: Bag of Words, Count Vectorizer, TF-IDF, Building a simple ML model for NLP applications, Basic issues in Machine Translation, Statistical translation, word alignment, phrase-based translation, and synchronous grammars.

B. Tech. CSE scheme Specialization: Blockchain

CSL239 Mathematics of Modern Cryptography

Modern Cryptography deals with the mathematics behind the theory of public key cryptosystems and digital signature schemes. This course will cover

essentials of cryptography topics that relate to blockchain technology and provide exposure to the students about the events or transactions that are secured cryptographically in blockchain. In this course, students will develop a thorough understanding of the mathematical foundations on which modern public-key cryptosystems are based. It will cover the core cryptographic techniques with an emphasis on those parts more relevant to Blockchain. The course will include concepts like public-key cryptography, hashing, and Merkle trees etc which are used for wallets, transactions, security, and privacy-preserving protocols in blockchain.

CSL247 Introduction to blockchain technologies

Blockchain technology enables peer-to-peer transfer of digital assets without any intermediaries. This course deals with the fundamentals of blockchain and the cryptographic concepts underlying the technology. In this course, students will acquire knowledge about what the blockchain technology is and how it works at a high level. Starting from the origin of Blockchain, its objectives and challenges to bitcoin data structure. The course will provide an exposure about how the blockchain technology is related to various other technologies and concepts like communication, consensus and architecture etc. It will also provide the students with a better understanding of the kind of problems best suited for blockchain-based solutions and evaluate the risk associated with the technology.

CSL355 Bitcoin and Cryptocurrency Technologies

Bitcoin is a digital payment currency that utilizes cryptocurrency, a digital medium of exchange and peer-to-peer (P2P) technology to create and manage monetary transactions as opposed to a central authority. The course includes the technical aspects of engineering secure software, system interactions with crypto-currencies, and distributed consensus for reliability. This course introduces to the world of cryptocurrency and mining applications. It includes different management strategies and regulatory frameworks for cryptocurrencies and explains how different methods are used to mine cryptocurrency.

CSL356 Smart Contracts

The course will provide an understanding of the concept of smart contracts and how to implement the business logic of a Smart Contract using business rules. The course will introduce the students to the concepts of Blockchain and its platforms like Bitcoin, Ethereum, Hyperledger and Multichain etc. It will discuss different reward schemes in blockchain technologies and how these can influence the development of smart contracts. It will provide an exposure about the critical role of smart contracts in transforming blockchain technology form enabling decentralised systems. In this course, students will be able to create decentralized apps that can harness the power of the blockchain for a wide variety of use cases.

CSL357 Blockchain for Cyber Security

Blockchain plays a crucial role in transforming cybersecurity solutions. This course introduces common cyberthreat landscape and common attacks such as malware, phishing, insider threats, and DDoS. It explains how Ethereum and Hyperledger architecture fit into the cybersecurity ecosystem. This course deals with adaptation of security triad with Blockchain. In this course student will be able to build Blockchain-based apps for two factor authentication, DDoS protection and develop Blockchain-based Public Key Infrastructure solutions and apps for storing DNS entries. This course also gives exposure to identify and resolve security issues with smart contracts.

CSL358 Blockchain Technology in Web Development

This course gives exposure to build an API server to interact with your blockchain and to host blockchain on a decentralized network. Course deals with decentralization and explain it is an important feature for securing a blockchain. In this course student will be able to build a consensus algorithm and use it to verify data and keep the entire blockchain network synchronized. Student will be able to build blockchain prototype and gain

a thorough understanding of why blockchain technology is so secure and valuable.

CSL449 Security and Privacy for Big Data Analytics

This course deals with the principles and mechanisms required to manage access controls in Big Data systems. In this course, students will gain knowledge about all security related issues in big data systems and projects. The students will learn the importance of data protection, understand the privacy risks arising from Big Data applications and methods which reduce or prevent privacy risks of data processing activities. The course will also cover system and network vulnerabilities, exploitation and defence mechanisms.

CSL455 Cloud Infrastructure and Services

This course introduces to the basic concepts and features of cloud computing and deals with the implementation of Cloud, Apache and Hadoop framework and related services. It demonstrates various issues of cloud computing and different cloud models. In this course, student will be practically able to attain the knowledge of virtualization through virtualization technologies and data storage. It also demonstrates the implementation of few algorithms with the help of MapReduce and some high-level language. Spark platform, HBase. High level map-reduce language-Hive or Pig.

B. Tech. CSE scheme
Specialization : Cloud Computing

CSL225 Programming for Data Science

Course Introduction: What is Data Science Environment Set-Up–Anaconda Jupyter Overview Core Programming Principles built-in data types, conditional constructs, looping constructs, logical expression, control statements, Fundament also of Python Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences, Strings, Tuples, Lists and Class Definition, Constructors, Inheritance – Overloading, Text & Binary Files - Reading and Writing ,Python for Data Analysis, NumPy, Pandas - Matrices and Data, Frames, Visualization in Python, (Matplotlib, Seaborn Pandas Built-in Data Visualization Advanced

Visualization in Python,Plotly and Cufflinks Geographical Plotting.

CSL238 Introduction to Cloud Computing

Cloud Computing Overview, Cloud Computing definition and characteristics (elasticity, multi-tenant, on-demand, ubiquitous access, usage metering, self-service etc.), General Benefits and Architecture, Business Drivers, Main players in the Field, Cloud service models/types (public, private, hybrid, and community clouds), Overview of Security Issues, Cloud deployment models (IaaS, PaaS, SaaS, Paas) and XaaS Cloud Based Service Offerings, EC2, SimpleDB, S3, Simple Queue, Simple Relational Database, Elastic MapReduce, Virtual Amazon Cloud. S3 Command Line tool, AWS APIs, MapReduce, HIVE, Microsoft Cloud Platform, Google cloud Platform

CSL337 Cloud Architecture

Cloud Service Models, Cloud Ecosystem, Cloud Delivery Models, Public Cloud Platforms – AWS, Microsoft Azure, Google App Engine. Algorithms and Programming Patterns for Cloud Applications – Task, Data and Pipeline Parallelism, Map-Reduce and Hadoop, Graph Analytics and Giraph.

CSL338 Virtualization & Cloud Computing

Virtualization and Virtual Machines, Implementation levels of Virtualization, VMM Design Requirements, Middleware Support for Virtualization, Virtualization Mechanism and Tools, Virtualization of CPU, Memory and I/O devices, Virtual Clusters and Resource Management, Virtualized Data Centers

CSL339 Big Data on Cloud

Introducing Big Data and Hadoop, what is Big Data and where does Hadoop fit in, two important Hadoop ecosystem components, namely, MapReduce and HDFS, in-depth Hadoop Distributed File System – Replications, Block Size, Secondary Name node, High Availability and in-depth YARN – resource manager and node manager. Distributed database architecture. No Sql databases with RDD. Data Frames and Spark SQL: The detailed Spark SQL, the significance of SQL in Spark for working with structured data processing, Spark SQL JSON support, working with XML data and parquet files, creating Hive Context, writing Data Frame to Hive, how to read a JDBC file, significance of a Spark Data Frame,

how to create a Data Frame, what is schema manual inferring, how to work with CSV files, JDBC table reading, data conversion from Data Frame to JDBC, Spark SQL user-defined functions, shared variable and accumulators, how to query and transform data in Data Frames, how Data Frame provides the benefits of both Spark RDD and Spark SQL and deploying Hive on Spark as the execution engine. Integrating Apache Flume and Apache Kafka: Why Kafka, what is Kafka, Kafka architecture, Kafka workflow, configuring Kafka cluster, basic operations, Kafka monitoring tools, integrating Apache Flume and Apache Kafka, Fundamentals of Hadoop, YARN& EMR cluster. Apache Sqoop introduction, Introducing Hadoop Hive, detailed architecture of Hive, comparing Hive with Pig and RDBMS, Comprehensive knowledge of HDFS, MapReduce, Hive, Pig, Oozie, Sqoop, Flume, ZooKeeper and HBase.

CSL346 Artificial Intelligence & Machine Learning on Cloud

Introduction Cloud Computing. Introduction to Machine Learning, Types of Learning: Supervised, Unsupervised, Reinforcement. Learning System: Well posed learning problem, Designing a learning system, Issues in machine learning. How cloud is related to ML, Amazon Web Services Cloud Platform: AWS Management Console, AWS Command Line Interface, Software Development Kits. Analytics: Athena, Amazon EMR, Amazon CloudSearch, Amazon Elasticsearch Service, Amazon Kinesis, AWS Cost Management, Business Application, Compute services, EC2 Auto-Scaling, Container Registry, VMware Cloud on AWS, Databases: Aurora, RDS, DynamoDB etc. Security Identity and Compliance: Identity and access Management, Security Hub, GuardDuty, Inspector, AWS Single Sign-On (SSO), AWS Shield, AWS Organizations, AWS Key Management Service, Firewall Manager, Storage: AWS Storage Gateway, Amazon S3, Amazon Elastic Block Store, Amazon S3 Glacier, Amazon FSx for Windows File Server, Amazon FSx for Lustr, Amazon Elastic File System, Introduction to AWS Machine Learning Services. Machine Learning for business challenges, Exploring Machine learning Toolset, Maths for machine Learning, Managing ML Projects, Power ML at scale, ML security, Developing Machine Learning Applications: Introduction to Amazon SageMaker, Introduction to Amazon SageMaker Neo, ML Algorithm, Automatic Model Tuning in Amazon SageMaker, Advanced Analytics with Amazon SageMaker, Anomaly Detection on AWS, Building Recommendation Systems with MXNet and GluOn, Deep learning Landscape, Deep Learning process for build, train and deploy, challenges with deep learning Projects.

CSL445 Cloud Application Development & Deployment

Technical architecture considerations – concurrency, speed, and unpredictable loads. Agile development, team composition (including roles/responsibilities), working with changing requirements and aggressive schedules. Understanding Model View Controller (MVC); Advanced understanding of "views", location, and the presentation layer: Advanced Ajax and JQuery. Presenting to different browsers and devices. Localization and internationalization; Understanding client location and device type. Mobile application development – Android, iOS, WP, RIM, Symbian. Session management. Advanced database techniques using MySQL and SQL Server, blob storage, table storage; Working with Third Party APIs: Overview of interconnectivity in cloud ecosystems. Working with Twitter API, Flickr API, Google Maps API. Advanced use of JSON and REST. containers and kubernetes. Virtual machines, containers, and Kubernetes. Relationship between Kubernetes and containers: Kubernetes orchestration, How Kubernetes was created, Kubernetes architecture, Kubernetes resource model, Key resources and pods, Kubernetes application deployment workflow.

CSL446 Cloud Security

Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, challenges, and Risks. Security Architecture, Cloud Computing Architecture, Control over Security in Cloud Model, Security Concerns,

Accessing Risk Tolerance in Cloud Computing, Legal and Regulatory Issues, Introduction to AWS Machine Learning Services. Machine Learning for business challenges, Exploring Machine learning Toolset, Maths for machine Learning Security requirements for the Architecture, Security Patterns and Architectural Elements, Cloud Security Architecture, Planning Key strategies for secure operations, Overview of Data Security in Cloud Computing, Data Encryption, Cloud Data Storage, and Cloud Lock-in. Overview and Limits of Security Controls, Security Monitoring, Building an Internal Cloud, Selecting an External Cloud, Evaluating Cloud Security, operating a Cloud and Using Mobile Cloud. Federation level in the Cloud, How Encrypted Federation Differs from Trusted Federation, Federated Services and Applications, Protecting and Controlling Federated Communication, Privacy and Its Relation to Cloud-Based, Information Systems: Privacy Risks and the Cloud, Protecting Privacy Information, Fully and Partial Encryption, Homomorphic Encryption, Cloud Security and comprehensive.

A. The overall credits structure of BCA

Credits Structure			
Category		Credits	Total Credits
Programme Core (PC) + Compulsory Courses		66	66
Electives	Programme Electives (PE)	16	28
	Open Electives (OE)	12	
Ability Enhancement Courses (AEC)		3	16
Skill Enhancement		2	4
Industry Internship + Project		15	15
	TOTAL	**129**	**129**

B. Programme Core (PC) + Compulsory Courses

S N	Code	Course Name	L-T-P	Credits
1.	MAL153	Mathematics -1	3-1-0	4
2.	BCL103	Programming Fundamentals – I	2-0-4	4
3.	BCL105	Programming Fundamentals – II	2-0-4	4
4.	MAL304N	Probability and Statistics	3-1-0	4
5.	BCL201	Data Structures	3-0-2	4
6.	BCL202	Computer Networks	3-0-2	4
7.	BCL203	DBMS	3-0-2	4
8.	BCL204	Operating Systems	3-0-2	4
9.	BCL205	Computer Architecture	3-0-2	4
10.	BCL206	Analysis and Design of Algorithms	3-0-2	4
11.	BCL303	Introduction to AI and ML	3-0-2	4
12.	BCL305	Software Engineering	3-0-2	4

13.	BCL110	Problem Solving and Design thinking	2-0-2	3
14.	BSL101	Entrepreneurship	2-0-2	3
15.	BCL102	Principles of Management	2-0-2	3
16.	PCL102	Phycology for living	2-0-4	4
17.	CLL102	Effective Communication – I	2-1-0	2.5
18.	CLL101	Effective Communication – II	2-1-0	2.5
		Total Credits		**66**

C. Programme Electives (PE)

S. No.	Code	Course Name	L-T-P	Credits
PE-I				
BCA with Specialization in Animation and Gaming				
1	BCL211	Foundations of 2D Game Development	2-0-4	4
2	BCL222	Fundamentals of Web application development	2-0-4	4
3	BCL311	Basics of 3D Animation	2-0-4	4
4	BCL312	Game Art Essentials	2-0-4	4
BCA with Specialization in Web Application Development				
1	BCL221	UI / UX Design principles	2-0-4	4
2	BCL222	Fundamentals of Web application development	2-0-4	4
3	BCL321	Fundamentals of Mobile application development	2-0-4	4
4	BCL322	Software prototyping, usability & testing	2-0-4	4
Foreign Language and open Electives				
11	CLL220	German – I	1-2-0	3
12	CLL200	French – I	1-2-0	3
13	CLL270	Spanish – I	1-2-0	3
		Open Elective -1	3-0-0	3
		Open Elective -2	3-0-0	3
		Open Elective -3	3-0-0	3

D. Ability Enhancement Courses (AEC)

S. No.	Code	Course Name	L-T-P	Credits
1	ASL140	Environmental Studies	3-0-0	3
2	CLL120	Human Values and Ethics	3-0-0	3
3	BCR118 GP – 1 BCR119 GP – 2 BCR218 GP – 3 BCR219 GP – 4 BCR318 GP – 5 BCR319 GP – 6			6
4	BCS101 BCS102 BCS201 BCS202 BCS301 BCS302	Community Service		4
		Total Credits		16

E. Skill Enhancement

S. No.	Code	Course Name	L-T-P	Credits
1.	BCV201	Skill Deveoplement-1	1-0-2	2
2.	BCV301	Skill Development-2	1-0-2	2
3.	BCD301	Project – 1	0-0-8	4
4.	BCD301	Project – 2	0-0-12	6
5.	BCD302	Summer Internship		5
		Total Credits		19

Outline of Choice based credit system (CBCS):

1. **Programme Core:** A course, which should compulsorily be studied by a student as a core requirement is termed as a programme core course.
2. **Programme Elective:** Elective courses may be offered by the main discipline/subject of study is referred to as Programme Elective. The University may also offer Programme related elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).
3. **Generic (or Open) Elective:** An elective course generally chosen from an unrelated discipline/subject, with an intension to seek exposure is called a Generic (or Open) Elective.
4. **Ability Enhancement Courses (AEC):** These are the courses based upon the content that leads to knowledge enhancement. They are English/Communication courses.
5. **Skill Enhancement/Project/Dissertation:** The Project work/ Dissertation based on application of Mathematics, Computer applications, Research project and new innovative ideas.

Bachelor of Computer Applications - (2021-2022)

Sem.	Semester Course Code, Course Name (L-T-P) Credits						Community Service	GP	Hrs. Per week			Credits
									L	T	P	
1	MAL153 Mathematics-I (3-1-0)4	CLL101 Effective Communication-I (2-0-1)2.5	BCL103 Programming Fundamentals - I (2-0-4)4	BSL102 Principles of Management (2-0-2)3	CHL100 Environmental Studies (3-0-0-)3		BCS101 (35 Hrs)	BCR118 GP – 1 (1-0-0-) 1 Credit	13	1	7	**17.5**
2	MAL206 Mathematical Statistics (3-1-0)4	CLL102 Effective Communication-II (2-0-1)2.5	CLL120 Human Values & Professional Ethics (2-0-0-)2	BCL104 Programming Fundamentals-II (2-0-4)4	BCL110 Problem Solving and Design Thinking (2-0-2)3	Foreign Language Elective 1 (1-2-0)3	BCS102 (35Hrs) 1 Credit	BCR119 GP- 2 (1-0-0-) 1 Credit	13	3	7	**20.5**
	Summer Training+ Community Service(70 hrs)											2
3	BCL201 Data Structures (3-0-2)4	BCL203 DBMS (3-0-2)4	PCL102 Psychology for living (2-1-0)3	BCL205 Computer Architecture (3-0-2)4	Open Elective – 1 (3-0-0)3	Program Elective-1 (2-0-4-)4	BCS201 (35 Hrs)	BCR218 GP – 3 (1-0-0) 1 Credit	17	1	10	**23**
4	BCL202 Computer Networks (3-0-2)4	BCV201 Skill Development -1 (1-0-2)2	BCL204 Operating System (3-0-2)4	Open Elective – 2 (3-0-0)3	Program Elective-2 (2-0-4)4	BCL206 Analysis and Design of Algorithms (3-0-2)4	BCS202 (35 Hrs) 1 Credit	BCR 219 GP-4 (1-0-0-) 1 Credit	16	0	12	**23**
Summer	Summer Training+ Community Service(70 hrs)											3
5	BSL101 Entrepreneurship (2-0-2)3	BCL303 Introduction to AI & ML (3-0-2)4	BCL305 Software Engineering (3-0-2-)4	Program Elective-3 (2-0-4-)4	BCV301 Skill Development -2 (1-0-2)2	BCD301 Project – 1 Semester at Industry/Startup Project (0-0-8)4	BCS301 (70 Hrs) 1 Credit	BCR318 GP-5 (1-0-0) 1Credit	12	0	20	**23**
6	Program Elective-4 (2-0-4)4	Open Elective-3 (3-0-0)3	BCD302 Project – 2 Semester at Industry/Startup Project (0-0-12)6				BCS302 (70 Hrs) 1 Credit	BCR319 GP-6 (1-0-0) 1Credit	06	0	16	**15**
						Total			77	5	72	**127**

Short Syllabus for BCA Courses (w. e. f. 2021-22)

Programme Core Courses

BCL103   Programming Fundamentals – I
(2-0-4) 4 credit

This course introduces the intrinsic concepts of computer fundamentals. It fully covers fundamental programming techniques with the most common library functions and the usage of the preprocessor. It includes Introduction to Computers and Number Systems, Hands-on Pseudocodes, Flowcharts, Algorithms, Introduction to C and Loops in C , Functions, Pointers, Arrays, Strings in C , Structures and File management in C . Students will be able to write the code of a program by developing logic with progression to writing pseudo codes, designing flowcharts and finally developing management projects.

MAL153   Mathematics-1
(3-1-0) 4 credits

Rank of a matrix, elementary transformations, elementary matrices, inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, consistency of linear system of equations, Orthogonal, Symmetric, skew symmetric, Hermitian Matrices, skew Hermitian Matrices, Normal and unitary Matrices and their properties, eigenvalues and eigenvectors, properties of eigenvalues, Cayley - Hamilton theorem and its applications, diagonalization of matrices, similar matrices. Double integral, change of order of integration, double integral in polar coordinates, applications of double integral to find area enclosed by plane curves, triple integral, change of variables, Differentiation of vectors, scalar and vector point functions. Gradient of a scalar field and directional derivative, divergence and curl of a vector field and their physical interpretations. Integration of vectors, line integral, surface integral, volume integral, Green, Stoke's and Gauss theorems (without proof) and their applications.

MAL304N   Mathematical Statistics
(3-1-0) 4 credits

Sampling Distributions, Introduction to statistics with examples, Graphical representation of data, Basic distributions, Properties, Fitting, Distribution Theory, Sampling distribution based on normal population, t- chi and F distributions, Moment generating functions, Sampling distributions and hypothesis testing

BCL205   Computer Architecture
(3-0-2) 4 credits
Boolean Algebra, Combinational Circuits, number system, FLOPS, Register Transfer Language, Register Transfer, Bus and Memory Transfer, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit. Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory Reference Instructions, Input-Output and Interrupt, addressing modes and instruction formats, hardwired vs. micro programmed programmed control unit. Through put and speed up. Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Direct Memory Access. Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, cache size vs block size mapping functions, Virtual Memory.

BCL201   Data Structures
(2-0-2) 4 credits

The course aims to teach the fundamentals of data structures, their design, implementation and effective use in problem solving approach. With the knowledge of data structures and practical experience in implementing them, students can become much more effective designer and developer. The course will start with the basic introduction of linear as well as non-linear data structures and further proceeds with the programming intensive task of implementing them. This course will also cover basics, arrays, linked lists, stacks, queues, trees graphs, searching and sorting techniques.

BCL203   Database management System
(3-0-2) 4 credits

This course aims to teach fundamentals of database management concepts as well as its implementation. It covers introduction to DBMS and database systems, database design with ER models,r elational database model, Normalization of data upto BCNF, relational algebra,transactions and recovery systems.

BCL202   Computer Networks
(3-0-2) 4 credits.

This course is designed to provide a complete overview of computer networking and covers everything from the fundamentals of networking technologies and protocols to practical applications.It includes Network Basics, Topologies, OSI Model, TCP/IP Model,I nternetwork devices, Transmission media, Analog/digital signals, Line encoding schemes, Data link layer protocols, error detection and correction techniques,IP addressing, Subnetting

concept,Routing protocols, Congestion control, IP datagram, TCP and UDP protocol protocols,DNS, DHCP, ICMP, Email protocols.

BCL204 Operating System
(3-0-2) 4 credits

This is an introductory course which briefs LINUX Operating System Concepts that forms an integral part of computer science engineering in development of software applications in many diverse areas, including Web Development, Windows Applications, Research, Analytics and Processing. It lays the foundation of Process Management & Scheduling, Memory Management, Deadlocks and other Operating system Concepts.

BCL305 Software Engineering
(3-0-2) 4 credits

This course helps students to understand about the systematic approach to the development, operation, maintenance, feasibility analysis, designing and requirement of the software. This course would cover different types of SDLC models, agile practices, requirement analysis and specification, designing document, testing techniques, Software maintenance and reuse approach, re-engineering, reverse engineering and project management techniques.

BCL303 Introduction to AI & ML
(3-0-2) 4 credits

This course aims to cover introduction to AI and Machine learning techniques. It includes fundamental of AI and machine learning, applications, different machine learning techniques: supervised and unsupervised learning, supervised regression and classification algorithms, unsupervised clustering algrithms, perfomance analysis of different machine learning algorithms.

BCL206 Analysis and Design Algorithms
(3-0-2) 4 credits

This course is an introduction to analysis of algorithms. The course will start with designing and analysis of basic algorithms like sorting and searching and will gradually cover advanced techniques such as dynamic programming and greedy algorithms. It will broadly cover : Role of

algorithms in computing, Algorithms as technology, analyzing and designing algorithms, Growth of Functions, Asymptotic notations, Recurrences, Substitution method, Recursion tree method, Master method. General method, binary search, merge sort, quick sort, selection sort, insertion sort. Greedy knapsack problem, job sequencing with deadlines,BFS, DFS, Activity selection problem. Dynamic Programming: General method, Principle of optimality, 0/1- knapsack, General method, 8-queen's problem, Travelling salesperson problem, Introduction to Branch and Bound, LC search and FIFO search, 0/1- knapsack.

BCL104 Fundamentals of Programming – II
(3-0-2) 4 credits

Procedural vs. Object-Oriented Programming, Literals , Variables and Identifiers , Operators, Expressions and Data Types, What Is a Control Structure, Boolean Expressions (Conditions), Relational Operators, Membership Operators, Selection Control, Multi-Way Selection, Iterative Control, While Statement , Infinite loops, Definite vs. Indefinite Loops, Boolean Flags and Indefinite Loops, List Structures, Common List Operations, Tuples , Nested Lists, For Loops , While Loops and Lists (Sequences), Assigning and Copying Lists , Dictionary Type in Python, Set Data Type , Program Routines , Defining Functions, More on Functions , Calling Value-Returning Functions, Calling Non-Value Returning Functions, Parameter Passing, Arguments in Python Default Arguments in Python, Variable Scope, Recursive Function, Module Specification , Top-Down Design, Developing a Modular Design of the Calendar Year Program, Object-Oriented Programming concepts, Numpy - Creation on Array ,Array generation from Uniform distribution, Random array generation, reshaping, maximum and minimum, reshaping, Arithmetic operations, Mathematical functions, Bracket Indexing and Selection, Broadcasting, Indexing a 2D array (matrices); Pandas - Creating a Series - from lists, arrays and dictionaries, Find Null Values or Check for Null Values, Reading data from csv, txt, excel, web, Visualization - Installing and setting up visualization libraries, Canvas and Axes, Subplots, Common plots – scatter, histogram, boxplot, Logarithmic scale, Placement of ticks and custom tick labels.

Compulsory Courses

BCL110   Problem Solving and Design
(2-0-2) 3 Credits

This course aims to teach the basics of problem solving and design thinking techniques and its real life applications. It starts with the Introduction to Problem Solving and Design Thinking, Principles of Design Thinking, Applications, Case studies and success stories, Difference between traditional thinking and design thinking approach, Lateral Thinking, Power of visual thinking, Preparing Your Mind for Innovation, Empathy Map, Defining the Problem Statement, Ideation tools, Prototyping, Testing and comletes with a capstone project.
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BSL101   Entrepreneurship
(2-0-2) 3 Credits

Introduction to Entrepreneurship, Benefits of Entrepreneurship, As a Career option, Entrepreneurial spirit, Entrepreneurial competencies, Entrepreneurship development programs, Entrepreneurial support, Policy initiatives for entrepreneurial growth, Ease of doing business; Social Entrepreneurship; Family Business, MSME's, Opportunity identification, Idea Generation; Conducting Feasibility analysis, Intellectual Property, Business Plan Preparation, Business Models, Porter's forces, Resource Mobilization: Entrepreneurial finance, Managing operations, Marketing strategies, Talent acquisition for new ventures; Project Management, Project appraisal, E-Business, Growth, Exit strategies, Social Responsibility

BSL102   Principles of Management
(2-0-2) 3 Credits

Management and analysis of basic organizing, leading, directing, and controlling for establishing and accomplishing business objectives, the scope of this study will also include aspects of the principles of management on individuals and organizations. The design of the course includes the basic mechanics business operations; manufacturing, marketing and maintaining financial focus in a rapidly changing and competitive market

CLL101   Effective Communication -1
(2-0-1) 2.5 Credits

Introduction to Communication, Types of Communication, Listening Skills, Language for Communication: Language and Communication; General Principles of Writing; Improving Writing Skills, Essentials of good style, Expressions and words to be avoided; Grammar and Usage, Communication Network: Scope and Types of Communication Network; Formal and Informal Communication Network; Upward Communication; Downward Communication; Horizontal Communication; Diagonal Communication,   Writing Business Letter: Importance of Business Letters.

CLL102   Effective Communication II
(2-0-1) 2.5 Credits   Lectures

Writing Memos, Circulars and Notices, Report Writing, Writing E-mail: Principles of E-mail; E-mail Etiquette; Overcoming Problems in E-mail Communication, Oral Communication Skills, Meetings: Types of Meetings, Reading, Employment Communication – Resume: Contents of Good Resume; Guidelines for Writing Resume; Different Types of Resumes; Reason for a Cover Letter to Apply for a Job-Format of Cover Letter; Different Types of Cover Letters, Public Speaking and Academic Writing.

PCL102   Psychology for Living
(2-1-0) 3 credits

The present course has been designed to encapsulate the major thrust areas in the discipline of psychology with focus on its relevance in everyday life. The course seeks to make a beginner student aware of their body image, intimacy, socialization process, and role of culture in themselves as mediated by the media. It also introduces the students to disintegrative experiences and ways of managing them, as well as to the process of self-growth and integration.

Programme Elective Courses

BCA Specialization for Web development

BCL221   UI / UX Design principles
(2-0-4) 4 Credits

The main objective of this Course is to provide a strong foundation in the design of User Interface and User Experience. Learner will learn how to solve a real-world UI/ UX design problem by using the best practices and conventions. They would learn how to create effective, compelling and navigation-friendly experiences for websites and mobile applications. By the end of this course the students will have the working capability of handling any project from scratch using various UI/ UX methodologies and will also have a full-fledged project in their portfolio. The following important topics will be included in this course: Introduction to UI and UX, Introduction to Internet and www, HTML, CSS and Bootstrap.

BCL312   Software prototyping, usability & testing
(2-0-4) 4 Credits

This design-centric course examines the broad question of what an interface is and what role a designer plays in creating a user interface. Learning how to design and articulate meaning using color, type, and imagery is essential to making interfaces function clearly and seamlessly. This is the course brings a design-centric approach to user interface (UI) and user experience (UX) design, and offers practical, skill-based instruction centered around a visual communications perspective, rather than on one focused on marketing or programming alone. This course is ideal for anyone with some

experience in graphic or visual design and who would like to build their skill set in UI or UX for app and web design. It would also be ideal for anyone with experience in front- or back-end web development or human-computer interaction and want to sharpen their visual design and analysis skills for UI or UX. This course is focused on the application of the early UX research to actual user interfaces: the creation of wireframes, high-fidelity mockups, and clickable prototypes. This course enhances the skills of the students by not only by providing usability but also the testing of the User Interface.

BCL222   Fundamentals of Web application development
(2-0-4) 4 Credits

Overview of HTML, CSS and Bootstrap; JavaScript basics, data types; language constructs – conditional, looping construct, function, arrays, methods, exception handling; object oriented concepts – constructors and inheritance; document object model, get input and output, style sheet manipulation using JavaScript, event handling, dynamic web page creation, single page Client-side applications designing, asynchronous programming, API calls, JQuery - JavaScript Object Notation (JSON) client and server object exchange.

BCL321   Fundamentals of Mobile application development
(2-0-4) 4 Credits

Introduction to Dart, basic data types, Dart language constructs – conditional constructs, looping constructs, function, methods, exception handling; object-oriented concepts – inheritance, abstract class, interface; Dart collection – List, Set and Map. Fundamental Flutter concepts, Stateful and Stateless Widgets, Widget tree, state management, animations, themes, Application Lifecycle, Exceptions and Errors, Interact with Gestures, Working with Multimedia, Database connectivity, Sensor, and hardware API call.

BCA Specialization for Gaming and Animation

BCL211   Foundation of 2D Game Development
(2-0-4) 4 Credits

This is an introductory course for students will learn how to program by creating your very own games using Unity3D, an industry-standard program used by many large gaming studios and indie developers across the world and Master basic game development (produce, test and present a beta version of a game of your own design). Understand game design and apply the concepts for game development. Students will also learn most common languages for game designers to learn are C++ and C# for unity will be able to operate and write Unity based C# program with Production Work Flow - 3Ds Max to Unity. By the end of the module, students will create a 2D platformer game.

BCL311   Basics of 3D Animation.
(2-0-4) 4 Credits

This course students will learn the principles of animation for film and games industry, basics to advance of 3D creation. This course is *project based* so we will be using the skills we learn along the way to create 3D animations. This course is designed on the essentially a digital successor to the stop motion techniques used in traditional animation with 3D models and frame-by-frame animation of 2D illustrations.

BCL312   Game Art Essential
(2-0-4) 4 Credits

This is course students will learn to create 2D and 3D assets essentials for game development with introduction of the skills required to create 3D Models in Industry Standard 3D Software efficiently. Students will learn different methods of modelling and texturing, and how to achieve good topology in a 3D model. Students will have the ability to develop, discuss, and implement from preproduction, to production, Assets for video game Industry. Students will have the skills to model, articulate, and render game requirement. Students will learn professional terms relating to real-time game asset creation.

Ability Enhancement Courses

ASL140   Environmental Studies
(3-0-0) 3 Credits
Through this subject, students will be studying issues like pollution, global climate change, and the depletion of natural resources, students in Environmental Studies & Earth Sciences programmes focus on the most pressing environmental and ecological issues of today.

CLL120   Human Values and professional ethics
(2-0-0) 2 credits

The object of this program is to develop ethical thinking abilities for decision making, self- control, and holistic approach towards life and professions. This program would also help them to understand the importance of harmony in self, family and society, along with learning to be more responsible towards environment and society. This program touches the topics like morals and values, integrity and honesty, and courage as a steppingstone towards a peaceful society. Topics like mindfulness, which has elements like framework of happiness quotient and Fueling success, is included to bringing one's attention to the internal and external experiences happening in the present moment. It will also help them develop a state of mind where they pay attention to their thoughts and feelings without judging them. This entire program focuses on developing self-control and confidence through education. As the students are soon going to become professionals, to make them future ready topics like Business Ethics, Corporate Social Responsibility and corporate Governance is also included, so that being into corporate they can be effective decision makers and handle their responsibilities towards the society and organization.

Open Elective Courses

Foreign Language Electives

CLL220   German-I
(1-2-0) 3 Credits

Greetings, Self-introduction, Learning alphabets, start a conversation, numbers from 0 to 1000, order in a restaurant and pay the bill, asking questions ,verbs in present tense, articles in nominative, use of dictionary, articles in accusative, verbs in accusative, negation, nouns: singular and plural, listen to umlauts and speak, speak about cities and tourist features, about countries and languages spoken there, to indicate the geographical location, the past tense of the verbs, accent in questions and statements, time data- clock time/ week days, To fix up appointments, to excuse oneself on being late, prepositions related to time.

CLL200   French-I
(1-2-0) 3 Credits

Introduce oneself and a friend/colleague or any other person, hobbies, leisure activities and daily routines, ask directions, to ask and to give personal information, give instructions, ask and tell time, understand a short and simple written passage, to organize, to accept or to refuse an outing/an invitation, leaving a message on the answering machine, place an order and pay in a restaurant, to speak about a near future plan and able to read a programme.

CLL270   Spanish-I
(1-2-0) 3 Credits

Personal information, exchange greetings, understanding conjugations, using the verbs "to have", "to be", learn numbers 1-100, nationalities, professions, express intentions/interests, explain reasons for actions, use of Present Indicative, use of prepositions, description of places and countries, talk about climate, use of superlatives, expressing agreement, doubt, future and past tenses, gender and number of adjectives, identification of objects, expression of needs, asking prices/products, give and ask for information about someone, knowledge about the company, number of employees, ability to talk about the post or job of someone in a company, read a technical drawing with dictionary, Irregular verbs.

Department of Electrical, Electronics and Communication Engineering
Master of Technology in Electronics and Communication Engineering
Specialization: Communication Engineering / VLSI Design

Program Core

		L-T-P	C
ECL513	Machine Learning	2-0-2	3
ECL523	Digital VLSI Design	2-1-0	3
ECL508	Wireless and Mobile communication	2-1-0	3
ECL570	Internet of Things	2-0-2	3
ECL527	Digital System Design with Verilog HDL	2-1-0	3
ECL501	Digital Signal Processing	2-1-0	3
ECL601	Cloud Computing	2-1-0	3

Lab Courses

		L-T-P	C
ECP510	Laboratory Training I	0-0-4	2
ECP518	Laboratory Training II	0-0-4	2

Research Skill Courses

		L-T-P	C
MAL616	Research Methodology	2-1-0	3
ECL603	Technical Writing Skills	2-0-0	2

Open Elective Courses

		L-T-P	C
	Open Elective – 1	2-1-0	3
	Open Elective – 2	2-1-0	3

Specialization based
Project & Dissertations (P)

		L-T-P	C
ECC509	Seminar	0-0-4	2
ECD512	Minor Project	0-0-6	3
ECD605	Dissertation (Phase-1)	0-0-12	6
ECD602	Dissertation (Phase-2)	0-0-20	10

*Open electives can be chosen from the University's list of Open Elective courses

Department of EECE
M. Tech in Electronics and Communication Engineering
(With specialization in Communication Engineering / VLSI Design)
2021

Semester	Course Code Course Name				Lecture Course	L	T	P	Week Cont. Hrs	Credits
I	ECL513 Machine Learning 2-0-2(3)	ECL523 Digital VLSI Design 2-1-0(3)	ECL508 Wireless and Mobile communication 2-1-0(3)	ECP510 Laboratory Training I 0-0-4 (2)	3	6	2	6	14	11
II	ECL570 Internet of Things 2-0-2(3)	ECL527 Digital System Design with Verilog HDL 2-1-0(3)	ECL501 Digital Signal Processing 2-1-0(3)	ECP518 Laboratory Training II 0-0-4(2)	3	6	2	6	14	11
III	ECL601 Cloud Computing 2-1-0(3)	*Open Elective-1 2-1-0 (3)	ECC509 Seminar (Specialization based) 0-0-4(2)		2	4	2	4	10	8
IV	ECD512 Minor Project (Specialization based) 0-0-6(3)	MAL616 Research Methodology 2-1-0(3)	ECL603 Technical Writing Skills 2-0-0 (2)		2	4	1	6	11	8
V	ECD605 Dissertation (Phase-1) (Specialization based) 0-0-12(6)	*Open Elective-2 2-1-0 (3)			1	2	1	12	15	9
VI	ECD602 Dissertation (Phase-2) (Specialization based) 0-0-20(10)				0	0	0	20	20	10
									84	57

*Open electives can be chosen from the list of Open Elective courses offered by the University. These may be run as Regular or MOOC.

M. Tech (Electronics and Communication Engineering)

ECL 513 Machine Learning
3 Credits (2-0-2)

Statistical Decision Theory - Regression, Classification, Bias Variance, Linear Regression, Multivariate Regression, Gradient Descent, Feature Scaling, Linear Classification, Logistic Regression, Decision Trees, Regression Trees, Random Forests, Multi-class Classification, Naive Bayes, K Nearest Neighbours, Perceptron, Support Vector Machines (SVM), Principal Components Analysis (PCA)

ECL 523 Digital VLSI Design
3 Credits (2-1-0)
MOS transistor, Enhancement and Depletion MOS transistors, Threshold Voltage, Fabrication and Modeling, MOSFET Scaling, CMOS Inverter, transfer characteristics, Power, Delay and Energy parameters, Combinational MOS Logic Design, Sequential MOS Logic Design, Static and Dynamic Latches and Registers, Low-Power Design Techniques, Design of Arithmetic Building Blocks, Memory Cells Design

ECL 527 Digital System Design with Verilog HDL
3 Credits (2-1-0)
ASIC Design Flow, Language Constructs and Conventions in Verilog HDL, Combinational Logic Design, Sequential Logic Design, Architecture of FPGA, Behavioral Modeling, Modeling Techniques, State Machine, Moore and Mealay State Model, Usr Defined Primitives, Programming Language Interface, Current Trends.

ECP510 Laboratory Training I
2 Credits (0-0-4)
This is a lab/practical course and the lab experiments related to the courses running in that semester will be conducted under this laboratory training.

ECL570 The Internet of Things
3 Credits (2-0-2)
Introduction; The IoT paradigm, Smart objects, Bits and atoms, Technologies behind the Internet of Things: RFID + NFC, Wireless networks + WSN, RTLS + GPS, Agents + Multiagent systems, IoT architecture, components, Application of IoT; IoT network connectivity techniques; IoT Platforms overview; Challenges in IoT: Security, Data Analytics, Protocols; Environmental challenges: excess waste disposal

ECL508 Wireless and Mobile Communication
3 Credits (2-1-0)
Access schemes, MAC protocols, problems and limitations of different protocols, cellular concepts, Evolution of mobile communication, GSM standard, call flows, location tracking, mobility management, GPRS, UMTS, Fading and Diversity effects in wireless communication, combining techniques, Spread spectrum, types, CDMA, SCDMA, capacity analysis, bit error analysis, power control, OFDM, MCDMA, MIMO Systems, Capacity analysis. Introduction to 4G and 5G, Case studies and analysis of Real time Situations

ECL501 Digital Signal Processing
3 Credits (2-1-0)

Basics of signal processing, Types of discrete type signals & Types of discrete time systems, Z transform, DFT, FFT, Digital filters-FIR,IIR, Multirate Signal Processing, Polyphase decomposition, Digital Filter Banks, Advanced Digital Signal Processors, Code Composer Studio, Introduction to RTOS, Introduction to DSP/BIOS and its components, Case studies and analysis of Real time Situations

ECP518 Laboratory Training II
2 Credits (0-0-4)
This is a lab/practical course and the lab experiments related to the courses running in that semester will be conducted under this laboratory training.

ECL 601 Cloud Computing
3 Credits (2-1-0)
Introduction to Cloud Computing, Cloud Computing Architecture, Service Management in Cloud Computing, Cloud Service Delivery Models, Data Management in Cloud Computing, Resource Management in Cloud, Cloud Security, Open Source and Commercial Clouds, Cloud Deployment Scenarios, Cloud Simulator, Research trend in Cloud Computing, Fog Computing

ECL603 Technical Writing Skills
2 Credits (2-0-0)
Writing Research Paper: Choosing Title of Paper, Style of Writing Research Paper, How to Write Abstract, Style of Reference Writing, Citation of Reference in Main Text of Paper, Using MS-Word to Write Research Paper, Review of Literature, How to Write Literature- Review Based Papers. Selection of Journals Report Writing: Structure and Layout of Report, Composing Report Writing a Research Proposal, Writing Synopsis, Writing Articles, Creating Resume, How to write a Case Study, How to Improve Research Productivity, Assignment on Technical Writing.

ECC509 Seminar
1 Credits (0-0-2)
Independent study on any recent research area of Electronics and Communication Engineering in the domain of Communication Engineering or VLSI Design, as per the specialization chosen by the student.

ECD512 Minor Project
4 Credits (0-0-8)
Hardware and software implementation of the latest research work in the domain of Communication Engineering or VLSI Design, as per the specialization chosen by the student. It has to be done under the guidance of a faculty and students are expected to complete literature survey, feasibility testing, develop or implement the research work.

MAL616 Research Methodology
3 Credits (2-1-0)
Foundations of Research, Scientific Research, Motivation, Research Objectives, Research Designs, Research Processes, Design of Experiments, Understanding Feasibility of Objectives and Processes, Qualitative and Quantitative Research Methods, Data Collection Processes, Biases in Data Collection, Data Pre-processing, Sampling Distribution and Confidence Intervals, Hypothesis Testing, Interpretation

of Results, Literature Review, Technical Writing, Citations, IPR, Research Ethics, Reference management software, Plagiarism, Software for Detection of Plagiarism

ECD 605 Dissertation (Phase-1)
6 Credits (0-0-12)
Simulation or hardware implementation of new or recent technological research trend under the guidance of a faculty. Students are expected to complete literature survey, feasibility testing, circuit design, component arrangement, development and publications. It has to be carried out in the domain of Communication Engineering or VLSI Design, as per the specialization chosen by the student.

ECD602 Dissertation (Phase-2)
10 Credits (0-0-20)
Completion of the research work and dissertation report submission, which was undertaken as ECD605. Simulation or hardware implementation of new or recent technological research trend under the guidance of a faculty, students are expected to complete literature survey, feasibility testing, circuit design, component arrangement, development and publications. It is the continuation of ECD605, and is in the domain of Communication Engineering or VLSI Design, as per the specialization chosen by the student.