AICTE MENDATORY DISCLOSURE

2021-2022

PERMANENT ID:1-4703201

1. **Name of the Institution:**

NAME	DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING , UNIVERSITY OF KALYANI
Address	UNIVERSITY OF KALYANI KALYANI, NADIA-741235 WEST BENGAL INDIA
Telephone	033-25025762
Mobile	9433112181
Email	registrarklyuniv@gmail.com

2. **Name and Address of the Trust/Society/Company and the Trustees**:NA
3. **Name and Address of the Principal**: Dr.Debansu Ray, Registrar, University of Kalyani, Kalyani Nadia-741235, West Bengal , India
4. **Name of the affiliating University**: NA
5. **Governance:**
   - **a.** Members of the Board and their brief background:

1. **Professor Manas Kumar Sanyal**
   Hon'ble Vice-Chancellor & Chairman of the 10th Executive Council
2. **Professor Goutam Paul**
   Hon'ble Pro-Vice-ChancellorUniversity of Kalyani

GOVERNMENT NOMINEES

3. **Shri Arup Sengupta, WBCS(Exe.)**
   Joint Secretary, Deptt. of Higher EducationScience & Technology and Bio-Technology
   Government of West Bengal
   Additional Chief Secretary's Nominee
4. **Financial advisor**
   Department of Finance
   Government of West Bengal, Nabanna,
   Mandirtala, Howrah – 711102
   Principal Secretary's Nominee(Finance)
5. **Nominee of the Chairman**
   West Bengal State Council of Higher Education
   Vaccant
6. **Dr. Madhumita Manna**
   Principal, Bidhannagar College
   DPI's Nominee

DEANS OF THE PG FACULTIES:

7. **Dean, PG Faculty of Science**
   University of Kalyani
   Vaccant
8. **Dean, PG Faculty of Arts & Commerce**
   University of Kalyani
   Vaccant
9. **Dean, PG Faculty of ETM**
   University of Kalyani
   Vaccant
10. **Dean, PG Faculty of Education**
    University of Kalyani
    Vaccant

NOMINEES OF THE AFFILIATED COLLEGES (Vice-Chancellor's Nominee)

11. **Dr. Sasim Kabiraj Thakur**
    Principal, Union Christian Training College (UCTC)
    Nominee of the Vice-Chancellor (Teachers' Training College)
12. **Dr. Samaresh Mandal**
    Principal, Berhampore College
    Nominee of the Vice-Chancellor
13. **Dr. Swagata Das Mohanta**
    Principal, Chakdaha College
    Nominee of the Vice-Chancellor
14. **Dr. Sujata Bagchi Banerjee**
    Principal, Krishnath College
    Nominee of the Vice-Chancellor (from general College)
15. **Dr. Arup Maity**
    Ranaghat College, Nadia
    Nominee of the Vice-Chancellor (from general College)
16. **Dr. Runu Das**
    Kalyani Mahavidyalaya, Kalyani, Nadia
    Nominee of the Vice-Chancellor (from general College)
17. **Dr. Hena Sinha**
    Berhampore Girls's College, Murshidabad
    Nominee of the Vice-Chancellor(Womens' College)

*For more details visit: http://www.klyuniv.ac.in/index.php/14-sample-data-articles/261-

statutory-bodies

b. Members of Academic Advisory Body:

1. Faculty of Engineering, Technology and Management (ETM): Dean, ETM

2. Head, Department of Computer Science & Engineering: Dr. Anirban Mukhopadhyay

3. All the Faculty of the Department of Computer Science & Engineering

(http://www.klyuniv.ac.in/index.php/academic/faculties/faculty-of-engineering-technology-management/computer-science-engineering)

4. Departmental Research Committee constitutes by internal members and external members.

5. Post Graduate Board of Studies (PGBOS) at Departmental Level :

Faculty Name	Designation
Dr. Jyotsna Kumar Mandal	Professor
Dr. Kalyani Mali	Professor
Dr. Utpal Biswas	Professor
Dr. Priya Ranjan Sinha Mahapatra	Professor
Dr. Anirban Mukhopadhyay	Professor
Dr. Debabrata Sarddar	Assistant Professor
Mr. Sukanta Majumder	Assistant Professor

c. Frequency of the Board Meeting and Academic Advisory Body:

- A good number of meeting are held in a year on the basis of requirement
- As per extent University Act, Statute and State Govt. guidelines.

d. Organizational chart and processes: http://www.klyuniv.ac.in/index.php/about-uok/organization-chart

e. Nature and Extent of involvement of Faculty and students in academic affairs/improvements: Faculty members participate in different academic bodies for improvements in academic matters. Student feedbacks are duly taken into consideration on framing academic affairs related policies

f. Mechanism/ Norms and Procedure for democratic/ good Governance: There are bodies at different hierarchical level to ensure democratic process and good governance as per extant regulatory requirements applicable to the Institution.

g. Student Feedback on Institutional Governance/ Faculty performance: Yes, It is taken regularly.

h. Grievance Redressal mechanism for Faculty, staff and students: Yes, It is available and DSW is nodal officer vide No.:R/Estab/Gen/19/DP-423.

i. Establishment of Anti Ragging Committee:

Every institution/ University including Deemed to be University imparting technical education shall constitute a Committee to be known as the Anti-ragging Committee to be nominated and headed by the Head of the Institution, and consisting of representatives of civil and police administration, local media, Non-Government Organizations involved in youth activities, representatives of faculty members, representatives of parents, representatives of students belonging to the freshers' category as well as senior students, non-teaching staff; and shall have a diverse mix of membership in terms of level as well as gender.
Also, a smaller body consisting of eight students under each of the faculty members of the department is formed for continuous monitoring at all times. Hostel warden is present at the hostels for active monitoring for any such events inside the hostel. Apart from this, the students can report any such incidents directly to the Head of the Department through the contact number given at the University website.

Head, Dept. of Comp. Sc. & Engg.
University of Kalyani, Kalyani
Nadia, (W.B) - 741235
India

Phone: (033) 2580-9615/17/14
EPBX: (033) 2582-8750 Ext.: 304/225
E-mail: hodcomputer_sci@klyuniv.ac.in
Name of the members with their official contact details is to be displayed in the website.

j. Establishment of Online Grievance Redressal Mechanism: Yes, for first level communication.

k. Establishment of Grievance Redressal Committee in the Institution and Appointment of OMBUDSMAN by the University

Committee Type	**Appointment order Reference number**	**Date of Appointment**	**Name**	**Profession**	**Address**	**Associated with**	**email**
OMBUDSMAN	R/Estab/Extn./18/DP-415	25/5/2018	Sushil Kumar Saha	Advocate	University of Klayani	University of Klayani	sushilsaha14@gmail.com
Grievance Readressal	RPS/N/48/1590/2016/S-890	30/11/2016	Debansu Ray	Principal	University of Kalyani	University of Kalyani	registrar@klyuniv.ac.in

l. Establishment of Internal Complaint Committee (ICC) : Yes, it is available.

m. Establishment of Committee for SC/ ST : Yes,it is available.

n. Internal Quality Assurance Cell:

The Members:

1)	The Hon'ble Vice-Chancellor, K.U.	-	**Chairman**
2)	The Hon'ble Pro-Vice-Chancellor, K.U.	-	Member
3)	The Dean, Faculty of Science, K.U.	-	Member
4)	The Dean, Faculty of ETM, K.U.	-	Member
5)	The Dean, Faculty of Arts & Commerce, K.U.	-	Member
6)	The Dean, Faculty of Education, K.U.	-	Member
7)	Prof. J.K. Mandal, Dept. of Comp. Science & Engg., K.U.	-	**Director**
8)	Prof. Nanda Kumar Ghosh, Dept. of Physics, K.U.	-	Member
9)	Prof. Nilashis Nandi, Dept. of Chemistry, K.U.	-	Member
10)	The Registrar, K.U.	-	Member
11)	The Controller of Examinations, K.U.	-	Member
12)	Prof. Swati De, Dept. of Chemistry, K.U.	-	Member
13)	Prof. Byasdeb Dasgupta, Dept. of Economics, K.U.	-	Member
14)	Dr. Bijan Sarkar, Dept. of Education, K.U.	-	Member
15)	The Development Officer, K.U.	-	Member
16)	Dr. Bibekananda Mukherjee, Dept. of Fine Arts, K.U.	-	Member
17)	Dr. Aniruddha Nag, AIR, India	-	Member
18)	Dr. Sukumar Kar (Alumni)	-	Member

6. **Programmes**

Name of Programmes approved by AICTE	MCA,MTECH(CSE)
Name of Programmes Accredited by NBA	NA

Name	Number of seats	Duration	Cut off marks/rank of admission during the last three years	Fee	Placement Facilities	Campus placement in last three years with minimum salary, maximum salary and average salary
MTECH	18	2yr		24000(GATE) per annum 40000(non_Gate) per annum		Placed-10. Min Salary-2 lakh(per annum) Max Salary-4 Lakh(per annum) Average salary-2.5 Lakh(per annum)
MCA	30	2yr		20000 per annum		Placed-25.

						Min Salary-1.5 lakh(per annum) Max Salary-4 Lakh(per annum) Average salary-2.5 Lakh(per annum)

7. Faculty:

Faculty	Permanet	Adjunct
Dr. Jyotsna Kumar Mandal	Yes	
Dr. Kalyani Mali	Yes	
Dr. Utpal Biswas	Yes	
Dr. Priya Ranjan Sinha Mahapatra	Yes	
Dr. Anirban Mukhopadhyay	Yes	
Dr. Debabrata Sarddar	Yes	
Mr. Sukanta Majumder	Yes	

- Permanent Faculty: Student Ratio: 1:16
- Number of Faculty employed and left during the last three years: Employed- 1

8. Profile of Principal:

i. Name – Dr. Debansu Ray, Registrar, University of Kalyani.

ii. Date of Birth - 23/12/1966

iii. Unique id - AFXPR8250D (PAN ID)

iv. Education Qualifications – Ph.D in Economics, M.A. in Economics.

v. Work Experience

- Teaching – 17 years
- Research – 24 years
- Industry - NIL
- Others - NIL

vi. Area of Specialization - Economics

vii. Courses taught at Diploma/ Post Diploma/ Under Graduate/ Post Graduate/ Post Graduate Diploma Level -NIL

viii. Research guidance

- No. of papers published in National/ International Journals/ Conferences -NIL
- Master -NIL
- Ph.D. -NIL

ix. Projects carried out -NIL

x. Patents - NA

xi. Technology Transfer - NA

xii. Research Publications – 10

Profile of Faculties:

Faculty Members	Details
Dr. Jyotsna Kumar Mandal	http://kucse.in/faculties.html
Dr. Kalyani Mali	http://kucse.in/faculties.html
Dr. Utpal Biswas	http://kucse.in/faculties.html
Dr. Priya Ranjan Sinha Mahapatra	http://kucse.in/faculties.html
Dr. Anirban Mukhopadhyay	http://kucse.in/faculties.html
Dr. Debabrata Sarddar	http://kucse.in/faculties.html
Mr. Sukanta Majumder	http://kucse.in/faculties.html

9. Fee

Sl. No.	**Particulars**	**MCA**	**M.Tech CSE**
1	Admission Fee (one time) *	500.00	500.00
2	Tuition/ Course Fee (yearly)	20000.00	#24000.00
3	Library Fee (one time) non refundable	80.00	80.00
4	Sports Fee (one time)	50.00	50.00
5	Laboratory Fee (p.a.)	200.00	200.00
5a	Computer Fee + Internet Facility (annual)	100.00	100.00

6	Session Fee (p.a.)	100.00	100.00
7	Registration Fee (one time) , if applicable**	100.00	100.00
8	Student Health Home (p.a.)	10.00	10.00
9	Fee for Identity Card (one time)	30.00	30.00
10	Immigration Fee** (one time) , if applicable	30.00	30.00
11	Development Fee (p.a.)	100.00	100.00
12	Students' Aid Fund (one time)	50.00	50.00
13	Prospectus & University Information	200.00	200.00
14	Examination Fee (p.a.) (for two semesters)	1200.00	1200.00
	TOTAL (including sl. no. 7 & 10)	**22750.00**	**26750.00**

For NET and GATE qualified students - Rs. 24,000.00 and for Non NET/ GATE students - Rs. 40,000.00 and for Sponsored students Rs. 50,000.00

* Registration Fee and Immigration Fee are applicable in case of students who have done graduation from any University other than University of Kalyani.

- Time schedule for payment of fee for the entire programme:
- No. of Fee waivers granted with amount and name of students: 02
- Number of scholarship offered by the Institution, duration and amount:0
- Criteria for fee waivers/scholarship: NA
- Estimated cost of Boarding and Lodging in Hostels: Boarding 1200 per year

10. Admission:

Number of seats sanctioned with the year of approval	MCA-30, Mtech-18 in 2021-22
Number of Students admitted under various categories each year in the last three years	MCA-26, Mtech-16 in 2018-2019 MCA-15, Mtech-10 in 2019-2020 MCA-27, Mtech-15 in 2020-2021
Number of applications received during last two years for admission under Management Quota and number admitted	NA

11**. Admission Procedure**:

Course Name	Admission Procedure	Address	Test Agency	URL

MCA	JECA	KOLKATA	WBJEE	
MTECH	University Entrance Exam	Kalyani University	GATE and Kalyani University	

- Number of seats allotted to different Test Qualified candidate separately (AIEEE/ CET (State conducted test/ University tests/ CMAT/ GPAT)/ Association conducted test)

Program	Test Type	Seat Allotted
MCA	JECA	30
MTECH	GATE and Kalyani University Test	18

12. Criteria and Weightages for Admission:

For Mtech:

1st class B.Tech. / B.E. in Computer Science & Engineering / Computer Science & Technology / Information Technology.

Or

1st class MCA [Preceded by B.Sc. with Honours (45% marks) in Physics / Mathematics / Statistics / Computer Science / Electronic Science or 1st class BCA (Marks 45% for SC / ST and 54% for OBC) or any B.E. / B.Tech.]

Or

1st class M. Sc. in Computer Science or equivalent degrees

For MCA:

Graduate or equivalent degree under (10+2+3) pattern in any discipline of a UGC recognized University/Institute or AICTE recognized BE/B.Tech/BCA of a University/Institute.

Candidate must have Mathematics as one of the subject at each level of education.

Candidates have to secure 60% marks (45% mark for SC/ST/OBC-A/OBC-B candidates) at each level of education.

13. List of Applicants

Mtech List:

SlNo	AIN	Name	Gender	Category	GATE Passing Year	Overall Merit score(30+40+30)
1	K21ETCSMT000593	SOUMIK DEY	Male	UNRESERVED	2021	71.505
2	K21ETCSMT000618	DIBYENDU ROY CHOWDHURY	Male	UNRESERVED	2019	68.913

3	K21ETCSMT000346	SREEJA RAY	Female	UNRESERVED	2021	59.691
4	K21ETCSMT000048	DEEP DEY	Male	UNRESERVED	NON-GATE	59.568
5	K21ETCSMT000011	SOUMYA KANTI MANDAL	Male	SCHEDULED CASTE Certificate From West Bengal	NON-GATE	58.932
6	K21ETCSMT000735	KUNAL SEN	Male	OBC-B Certificate From West Bengal	NON-GATE	56.78
7	K21ETCSMT000010	AISHIK SETT	Male	UNRESERVED	NON-GATE	56.636
8	K21ETCSMT000516	ROUNAK BHADRA	Male	OBC-B Certificate From West Bengal	NON-GATE	56.148
9	K21ETCSMT000002	ANTARA DAS	Female	UNRESERVED	NON-GATE	54.34
10	K21ETCSMT000013	SUDIP KUMAR BANERJEE	Male	UNRESERVED	NON-GATE	53.896
11	K21ETCSMT000008	SOHAM BISWAS	Male	SCHEDULED CASTE Certificate From West Bengal	NON-GATE	53.384
12	K21ETCSMT000021	ABHIMANYU CHATTERJEE	Male	UNRESERVED	NON-GATE	53.384

13	K21ETCSMT000130	SOUMYAJIT BASAK	Male	OBC-B Certificate From West Bengal	2021	52.706
14	K21ETCSMT000017	BARSHA BISWAS	Female	SCHEDULED CASTE Certificate From West Bengal	NON-GATE	52.64
15	K21ETCSMT000019	ANISHA BANIK	Female	UNRESERVED	NON-GATE	50.332
16	K21ETCSMT000139	DEBADRITA SAHA	Female	SCHEDULED CASTE Certificate From West Bengal	NON-GATE	50.152
17	K21ETCSMT000505	TRIJIT ARKA GHOSH	Male	UNRESERVED	NON-GATE	49.448
18	K21ETCSMT000701	ABHIJIT MANDAL	Male	UNRESERVED	NON-GATE	48.904
19	K21ETCSMT000004	PRIYANKA CHAKRABORTY	Female	UNRESERVED	NON-GATE	47.492
20	K21ETCSMT000719	ISHANI ROY	Female	UNRESERVED	NON-GATE	47.292
21	K21ETCSMT000232	SHILPA CHAKRAVORTY	Female	UNRESERVED	NON-GATE	46.732
22	K21ETCSMT000726	SHALINI BISWAS	Female	UNRESERVED	NON-GATE	46.572
23	K21ETCSMT000630	PRITAM CHAKRABORTY	Male	UNRESERVED	NON-GATE	44.068
24	K21ETCSMT000270	SWASTIKA	Female	UNRESERVED	NON-	43.184

		CHATTERJEE			GATE	
25	K21ETCSMT000614	TANMAY DAS	Male	SCHEDULED CASTE Certificate From West Bengal	NON-GATE	41.42
26	K21ETCSMT000005	ANUPAM KHATUA	Male	UNRESERVED	NON-GATE	41.096
27	K21ETCSMT000687	ANUPAMA SEN	Female	UNRESERVED	NON-GATE	40.664
28	K21ETCSMT000558	DIPANKAR BANERJEE	Male	UNRESERVED	NON-GATE	40.316
29	K21ETCSMT000669	BIDISHA MAITI	Female	UNRESERVED	NON-GATE	39.92
30	K21ETCSMT000007	SATYAM CHOUDHARY	Male	SC from Other State	2021	39.314
31	K21ETCSMT000673	RAMIZ RAJA	Male	UNRESERVED	NON-GATE	39.196
32	K21ETCSMT000106	MADHURIMA DATTA	Female	OBC-B Certificate From West Bengal	NON-GATE	37.736
33	K21ETCSMT000450	DEBI DUTTA	Female	UNRESERVED	NON-GATE	36.48
34	K21ETCSMT000507	URMI PURKAIT	Female	UNRESERVED	NON-GATE	36.16

35	K21ETCSMT000733	TUKU KHATUN	Female	OBC-A Certificate From West Bengal	NON-GATE	35.2
36	K21ETCSMT000014	MD RASIDUL ISLAM	Male	OBC-A Certificate From West Bengal	NON-GATE	34.424
37	K21ETCSMT000183	ROUNAK SARKAR	Male	SCHEDULED CASTE Certificate From West Bengal	NON-GATE	34.02
38	K21ETCSMT000009	TAPAS MURMU	Male	SCHEDULED TRIBE Certificate From West Bengal	NON-GATE	33.796
39	K21ETCSMT000001	RUPAK PAUL	Male	UNRESERVED	NON-GATE	33.508
40	K21ETCSMT000252	PRIYANKA SHOME	Female	UNRESERVED	NON-GATE	33.188
41	K21ETCSMT000594	JISHNO DAS	Male	SC Certificate From West Bengal	NON-GATE	32.616
42	K21ETCSMT000320	MUKULDEB RAKSHIT	Male	UNRESERVED	NON-GATE	31.864
43	K21ETCSMT000608	SHANKHAJIT DAS	Male	UNRESERVED	NON-GATE	31.624
44	K21ETCSMT000003	SAYAN KHAN	Male	UNRESERVED	NON-GATE	27.456

14. Results of Admission under management seats: NA

15. Information of Infrastructure and Other Resources Available

- Class and Tutorial Room, Laboratory, Drawing Hall Information

Room No	Room Type (Mension class room/lab/toilet, etc	Carpet area(in sq m)
CS-101	Class room	38.43
CS-102	Class room	38.43
CS-202	Class room	41.71
CS-303	Class room	41.71
CS-207	Class room	62.625
LB-201	Computer Lab	59.17
LB-301	Computer Lab	60.41
TR-203	Tutorial room	7.5
SH-101	Seminar Hall	140
LB-205	Communication Lab	26.075
LB-206	Sensor Network Lab	26.82
LAB209	Laboratory	32.85
LB-201	Laboratory	59.17
LB-301	Laboratory	60.101
A101	Class Room	91.5
A102	Laboratory	23.1
A103	Workshop	200
A203	Laboratory	31.17
A204	Laboratory	38
B101	Drawing Hall	92.5
B102	Class Room	34.5
B103	Class Room	46
B104	Laboratory	50
B105	Class Room	50
B106	Class Room	37.4
B201	Laboratory	119
C101	Tutorial Room	28
CR201	Tutoral Room	60.48
C102	Tutorial Room	43.6

- Fire Safety Certificate: In process
- Library Information

No of Books	No of Titles	No of Volumes	No of National Journal Subscriptions	No of International Journal Subscription
150000	3292	70370	0	10

- Laboratory and Workshop
    - List of Major Equipment/Facilities in each Laboratory/ Workshop

1. Two HP Work station
2. Digital Electronics Trainer Kits
3. Advance PC for Software Development
4. VLSI Design Simulator : Cogenda
5. Wireless Sensor Network Equipment
6. Arduino Kit

- List of Experimental Setup in each Laboratory/ Workshop

- Computing Facilities

Internet Bandwidth	Number of Systems	Configurations	Number of systems connected by LAN	Number of Systems connected by WAN	Major Software Packages	Special Facilities
1Gbps	100	i7/i5/i3 core, 4GB/8GB RAM, 1TB/500GB HDD	100	100	VLSI Simulator Cogenda , Office , Microsoft Professional	Wifi Throughout Campus

- Innovation Cell: NA
- Social Media Cell: NA
- Compliance of the National Academic Depository (NAD), applicable to PGCM/ PGDM Institutions and University Departments: Yes.
- List of Facilities Available:
  - Health Center.
  - Games and Sports Facilities: Recreation Hall, Basket Ball court, Cricket Ground, Football ground, Badminton court, Multi Gym, Swimming pool,
  - Extracurricular Activities: Academic Festival, Social, Cultural Activities, NCC
  - Soft Skill Development Facilities: Yes
- Teaching Learning Process:
  - Curricula and syllabus for each of the programs as approved by the University:

Department of Computer Science and EngineeringUNIVERSITY OF KALYANI, KALYANI 741235WEST BENGAL

SYLLABUS

FOR

MASTER OF TECHNOLOGY (M.Tech.) in COMPUTER SCIENCE & ENGINEERING

(Two-Year Programme)

As per

AICTE MODEL CURRICULUM

(Effective from the Session: 2021-22)

Paper Code Convention: CSE – XYZ
[X = 1/2/3/4 (semester), Y = 0/1/2/3 (theory/practical/project/viva), Z (paper id)]

Paper Code	Paper Name	Type	Credit	Weekly hours (L+T+P)	Marks Theory - (Exam+Internal Assessment)
Semester - I					
CSE–101	Advanced Operating Systems	Theory	4	3+1+0	100 (80+20)
CSE–102	Advanced Database Systems	Theory	4	3+1+0	100 (80+20)
CSE–103	Advanced Mathematics	Theory	4	3+1+0	100 (80+20)
CSE–104	Advanced Computer Architecture	Theory	4	3+1+0	100 (80+20)
CSE–105	Advanced Design and Analysis of Algorithms	Theory	4	3+1+0	100 (80+20)
CSE–111	Advanced Computing Lab-I	Practical	4	0+0+6	100
TOTAL			24	26	600
Semester - II					
CSE–201	Soft Computing	Theory	4	3+1+0	100 (80+20)
CSE–202	Mobile & Wireless Computing	Theory	4	3+1+0	100 (80+20)
CSE–203	Elective I	Theory	4	3+1+0	100 (80+20)
CSE–204	Elective II	Theory	4	3+1+0	100 (80+20)
CSE–205	Elective III	Theory	4	3+1+0	100 (80+20)
CSE–211	Advanced Computing and Communication Lab	Practical	4	0+0+6	100
CSE–221	Review Work & Seminar	-	6	-	100
TOTAL			30	26	700
Semester - III					
CSE–301	Elective IV	Theory	4	3+1+0	100 (80+20)
CSE–302	Elective V	Theory	4	3+1+0	100 (80+20)
CSE–311	Advanced Computing Lab-II	Practical	4	0+0+6	100
CSE–321	Thesis I	Project	12	0+0+20	300
TOTAL			24	34	600
Semester - IV					
CSE – 421	Thesis II	Project	18	0+0+24	400
CSE – 431	Grand Viva	Viva	6	-	200
TOTAL			24	24	600
Overall Total			102	110	2500

Total Marks for Two Year (4-Semesters) M. Tech.(CSE) Course is 2500, Total Credit is 110.
For sessional at least two intermediate exams are to be taken, average mark will be the sessional marks for each subject. Corrected paper of these intermediate exams is to be returned to the respective students. Topic must be different for each students in Seminar.

Elective Papers	
1. IoT and Sensor Networks 2. Machine Learning 3. Theory of Computing 4. Pattern Recognition 5. Artificial Intelligence 6. Advanced Software Engineering 7. Advanced Network Security & TCP/IP Programming 8. Blockchain Technology	9. Real Time & Embedded Systems 10. Management Information Systems 11. Optical Networks 12. Cloud Computing 13. Network Administration 14. High Performance Computing Architecture 15. Web Mining and Internet Technology 16. Authentication & Steganography 17. Data Warehousing and Data Mining 18. Digital Image Processing
* New elective papers may included/offered as per the need of the industry and modern technologies as and when required with the approval of the PG-BoS of Dept. of Computer Science & Engineering.	

Semester-I

CSE 101	Advance Operating Systems	L-T-P : 3-1-0	Credit: 4	40L

Distributed Systems : Hardware and Software concepts – Design issues;
Communication in Distributed systems : Layered protocols - ATM networks - Client Server model –Remote Procedure Calls.
Synchronization : Clock synchronization – Mutual exclusion – Election algorithms, - Atomic transactions – Deadlocks; Processes : Threads – System models – processor allocation – Scheduling – Fault tolerance – Real time distributed systems.

Shared memory : Consistency models – Page based distributed shared memory – Shared variables –Object based distributed shared memory; Distributed File Systems : Design and Implementation.

Case Study: Introduction to Amoeba – Object and Capabilities – memory management – Communication – Amoeba Servers.

Text Books:

1. Mukesh Singhal, Niranjan G Shivratri , " Advanced Concepts in Operating Systems", McGraw Hill International, 1994.
2. Silbersehatz A. and Peterson J. L., "Operating System Concepts", Wiley.

Reference Books:

1. Andrew S Tanenbaum , " Distributed Operating Systems " , Pearson Education India, 2001.
2. Pradeep K Sinha , " Distributed Operating Systems Concepts and Design ", PHI, 2002.

CSE 102	Advance Database Systems	L-T-P : 3-1-0	Credit: 4	40L

Relational Database Management Issues - Transaction Processing, Concurrency, Recovery, Securityand Integrity.
Distributed Databases - Storage structures for distributed data, data fragmentation, Transparency of distributed architecture, Distributed query processing, Transaction management in distributed environment, Recovery and Concurrency control, Locking protocols, Deadlock handling, Dynamic modeling of distributed
databases, Client - Server Databases.
Performance Tuning, Advanced Transaction Processing.
Object-oriented Databases - Objects and Types, Specifying the behavior of objects, ImplementingRelationships, Inheritance.
Sample Systems.

New Database Applications.
Multimedia Database - Multimedia and Object Oriented Databases, Basic features of Multimedia data management, Data Compression Techniques, Integrating conventional DBMSs with IR and HierarchicalStorage Systems, Graph Oriented Data Model, Management of Hypertext Data, Client ServerArchitectures
for Multimedia Databases

Text Books:
1.H. F. Korth & A. Silverschatz: Database Systems Concepts, McGraw Hill.
2.Bindu R. Rao: Object Oriented Databases, McGraw Hill, 1994.
3. Gray, Kulkarni, and Paton: Object Oriented Databases, Prentice Hall International, 1992.4.Khoshafian: Object Oriented Databases, John Wiley & Sons, 1993.

Reference Books:
1. S. Khoshafian & A. B. Baker, Multimedia and Imaging Databases, Morgan Kaufmann Publishers, 1996.
2. Kemper & Moerkoette: Object-Oriented Database Management, PH, 1994.
3. Alex Berson: Client/Server Architecture, McGraw Hill.

CSE 103	Advance Mathematics	L-T-P : 3-1-0	Credit: 4	40L

Combinatorics: Multinominal theorem, principle of inclusion; Recurrence relations – classification, summation method, extension to asymptotic solutions for subsequences; Linear homogeneous relations,characteristic root method, general solution for distinct and repeated roots, non-homogeneous relations and examples, generating functions and their application to linear homogeneous recurrence relations, non-linear recurrence relations, exponential generating functions, brief introduction to Polya theory of counting.

Graph Theory: Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits ingraphs and tournaments, trees; Minimum spanning tree, rooted trees and binary trees, planar graphs, Euler's formula, statement of Kuratowskey's theorem, dual of planer graph, independence number andclique number, chromatic number, statement of Four-color theorem, dominating sets and covering sets.

Logic: Propositional Calculus- propositions and consecutives, syntax; Semantics- truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of consecutives; Equivalence and normal forms; Compactness and resolution; Formal reducibility – natural deducation system and axiom system; Soundness and completeness.

Introduction to Predicate Calculus: Syntax of first order language; Semantics- structures and interpretation; Formal deductibility, First Order theory, models of a first order theory (definition only),validity, soundness, completeness, compactness (statement only), outline of resolution principle.

Text Books:
1. J.L. Mott, A. Kandel and T.P. Baker: Discrete Mathematics for Computer Scientists, Reston, Virginia, 1983.
2. D.F. Stanat and D.E. McAllister: Discrete Mathematics in Computer Science, Prentice Hall, Englewood Cliffs, 1977.
3. R.A. Brualdi: Introductory Combinatorics, North-Holland, New York, 1977.
4. Reingold et al.: Combinatorial algorithms: theory and Practice, Prentice Hall, Englewood Cliffs, 1977.
5. J.A. Bondy and U.S.R. Murthy: Graph Theory with Applications, Macmillan Press, London, 1976.
6. N. Deo: Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, Englewood Cliffs, 1974.
7. E. Mendelsohn: Introduction to Mathematical Logic, 2nd Ed. Van-Nostrand, London, 1979.
8. L. Zhongwan: mathematical Logic for Computer Science, World Scientific, Singapore, 1989.
9. F.S. Roberts: Applied Combinatorics, Prentice Hall, Englewood Cliffs, 1984.

Reference Books:
1. J.P Tremblay and R. Manohar: Discrete Mathematical Structures with Applications to Computers.
2. J.L. Gersting: Mathematical Strcutures for Computer Sciences.
3. S. Lipschutz: Finite Mathematics.
4. S. Wiitala: Discrete Mathematics – A Unified Approach.
5. C. L. Liu : Elements of Discrete Mathematics.
6. K . D. Joshi : Foundation of Discrete Mathematics.
7. S. Sahani : Concept of Discrete Mathematics.
8. L. S. Levy : Discrete Structure in computer Science.
9. J. H. Varlist and R. M. Wilson: A course in Combinatorics.

CSE 104	Advanced Computer Architecture	L-T-P : 3-1-0	Credit: 4	40L

Fundamentals of Computer design- Technology trends- cost- measuring and reporting performancequantitative principles of computer design.
Memory hierarchy design- cache performance- reducing cache misses penalty and miss rate – virtual memory- protection and examples of VM.
Instruction set principles and examples- classifying instruction set- memory addressing- type and size of operands- addressing modes for signal processing-operations in the instruction set- instructions for control flow- encoding an instruction set.-the role of compiler.
Instruction level parallelism (ILP)- over coming data hazards- reducing branch costs –high performance instruction delivery- hardware based speculation- limitation of ILP
ILP software approach- compiler techniques- static branch protection – VLIW approach – H.W supportfor more ILP at compile time- H.W versus S.W Solutions
Multiprocessors and thread level parallelism- symmetric shared memory architectures- distributedshared memory- Synchronization- multi threading.

Text Book:
1. Computer Architecture A quantitative approach 3rd edition John L. Hennessy & David A. PattersonMorgan Kufmann (An Imprint of Elsevier)

Reference Books:
1. Advanced Computer Architectures, Dezso Sima, Terence Fountain, Peter Kacsuk, Pearson.
2. “Computer Architecture and parallel Processing” Kai Hwang and A.Briggs International Edition McGraw-Hill.

CSE 105	**Advanced Design and Analysis of Algorithms**	**L-T-P:3-1-0**	**Credit: 4**	**40L**

Quick Review of basic concepts - complexity measures, worst-case, average case and amortizedcomplexity functions, model of computation.

Algorithm Design Paradigm - Divide and Conquer, Recursion, Greedy method, Dynamic programming.Role of Data Structures.

Sorting and Selection Problems: Order Statistics, sorting methods, lower bounds. Searching and

Selection Problems: Order Statistics, sorting methods, lower bounds.

Searching and Set manipulation: Searching in Static table - path lengths in Binary trees and applications,
optimality of Binary search in worst case and average case, construction of weighted Binary Searchtree. Searching in dynamic table - randomly grown binary search trees, AVL trees, (a, b) trees; Union-findproblem - tree representation of set, weighted union and path compression, analysis and application. Hashing: chaining, open addressing, universal hashing function.

Graph algorithms: Review of topological sort, connected and biconnected components, shortest paths,minimum spanning trees. Maximum matching, maximum-flow (Ford-Fulkerson).

Arithmetic and Algebraic problems: Integer multiplication, GCD, Polynomial evaluation, MatrixMultiplication, Lower Bounds. Introductory Stringology. Some geometric algorithms.

NP-completeness: Determinism and non-determinism, P, NP, NP-complete, Cook's theorem, Some NP complete problems, Approximation algorithms. Notion of Randomization and Parallelism in algorithms.

Text Books:

1. T. H. Cormen, C. E. Leiserson and R. L. Rivest: Introduction to Algorithms, MIT Press, 1990.
2. U. Manber: Introduction to Algorithms, Addison-Wesley, 1989.

Reference Books:

1. G. Brassard and P. Bartley: Algorithmics: Theory and Practice, Prentice Hall International 1996.
2. A. V. Aho, J. E. Hopcroft and J. D. Ullman: Design and Analysis of Algorithms, Addison-Wesley, 1974.

CSE 105	**Advanced Computing Lab - I**	**L-T-P : 0-0-6**	**Credit: 4**	**FM: 60P**

Semester-II

CSE 201	**Soft Computing**	**L-T-P : 3-1-0**	**Credit: 4**	**40L**

Fuzzy Logic and Approximate Reasoning:
Conventional and fuzzy sets: Basic concepts of fuzzy logic
Fuzzy expressions: Basic principles of fuzzy logic and fuzzy inference rules, fuzzy relations, fuzzyoperators, realization of fuzzy systems using fuzzy relations

Application of fuzzy logic in vision, pattern recognition, robotics and linguistics. Approximate reasoning in Experts Systems, Fuzzy sets in approximate reasoning, Fuzzy propositions in approximatereasoning. Transition Modifier rules, Basic principles of approximate reasoning and rules of inference.Genetic Algorithms (GAs): Introduction to GAs, Binary encodings of candidate solutions, Schema Theorem and Building Block Hypothesis, Genetic operators – crossover and mutation, parameters for GAs, Reproduction mechanism for producing Offspring, Darwinian Principle in evaluating objective function. Convergence Analysis: Simple GA schemes, Stochastic models: GA approaches to optimization problems.
Basic Concepts and Principles of Neural Networks (NNs) and Learning Systems.
Learning with GAs and Artificial NNs (ANNs); Composite use of Fuzzy Logic, ANNs and GAs.
Neurocomputing: Models of Neurocomputing: (a) Perceptron Training, (b) Back propagation learning, (c) Hopfield nets, (d) Adaptive resonance theory I & II, (e) Self-organizing feature map, (f) ADALINE.
Applications in pattern classification and image understanding.
Chaos Theory, Fusion of Neuro, Fuzzy, GA & Chaos theory & Applications to simple problems.

Text Books:

1. David E. Goldberg: Genetic Algorithms in Search, Optimization and Machine Learning, Addision Wesley, MA, 1989.
2. S. Haykin: Neural Networks - A Comprehensive Foundation, Macmillan College Publishing Company, New York, 1994.
3.H. J. Zimmermann: Fuzzy set theory and its application, 2nd revised edition, Allied Publishers Ltd.
4. G. J. Klir, B. Yuan: Fuzzy sets and Fuzzy logic: Theory and Applications, PHI, 1995.
5.R. L. Devaney: An Introduction to Chaotic Dynamical Systems, 2nd Ed. Addision Wesley, 1989.
6. An Introduction to Genetic Algorithms – M. Mitchell.
7. Genetic Algorithms – K. F. Man, K. S. Tang and S. Kwong.
8. Genetic Algorithms + Data Structures = Evolution Programs – Z. Michalewicz.
9. Adaptation in Natural and Artificial Systems - J. H. Holland.
10. Genetic Algorithms : for VLSI Design, Layout & Test Automation – P. Mazumder and E. M Rudnick.

Reference Books:

1. Neuro- Fuzzy and Soft Computing : A Computational Approach to Learning and Machine Intelligence - J. S. R. Jang C. T. Sun and E. Mizutani.
2. Theory and Practice of Uncertain Programming – B. Liu.
3. Fuzzy Logic for the Applications to Complex Systems – W. Chiang and J. Lee.
4. Fuzzy Logic with Engineering Applications – T. J. Ross.
5. Neural Network and Fuzzy Systems : A Dynamical Systems Approach to Machine Intelligence – B. Kosko.

CSE 202	**Mobile & Wireless Computing**	**L-T-P : 3-1-0**	**Credit: 4**	**40L**

Wireless Transmission-Wired and wireless, Mobility of users and equipment, Electromagnetic Spectrum,
Radio and Microwave communication, Infrared and Millimeter waves, Legthwave Transmission. Satellite Network Architecture-Satellite Orbits-GEO LEO, MEO. Inmarsat, Iridium, Odyssey, GlobalStar, Archimedes and other Satellite Networks.
Spread Spectrum and CDMA-Direct (pseudo-noise) and Frequency hopped Spread Spectrum. CDMA System.
Wireless LANs -MACA and MACAW protocols. Infrared LAN. Cellular Radio Systems-Paging, Cordless telephones, Analog Cellular telephones AMPS. Digital Cellular Telephone-GSM. Personal Communication service (PCS).CDPD system. Mobile Data Networks and their applications.Wireless and Mobile access to the Internet.

Text Books:

1. V. K. Garg & J. E. Wilks: Wireless and Personal Communication Systems: Fundamentals andApplications

IEEE Press and Prentice Hall, 1996.

2. T. S. Rappaport, B. D. Werner and J. H. Reed: Wireless Personal Communications: The Evolution of PCS,

Dkyener Academic, 1996.

Reference Books:

1. G. I. Stuber: Principles of Mobile Communication, Kluener Academic, 1996.
2. U. Black: Mobile and Wireless Networks, Prentice Hall PTR, 1996.

CSE 203	**Elective – I**	**L-T-P : 3-1-0**	**Credit: 4**	**40L**
CSE 204	**Elective -II**	**L-T-P : 3-1-0**	**Credit: 4**	**40L**
CSE 205	**Elective -III**	**L-T-P : 3-1-0**	**Credit: 4**	**40L**
CSE 211	**Advanced Computing and Communication Lab**	**L-T-P:0-0-6**	**Credit: 4**	**60P**
CSE 241	**Review Work and Seminar**	**L-T-P : NA**	**Credit: 6**	

Semester-III

CSE 301	**Elective - IV**	**L-T-P : 3-1-0**	**Credit: 4**	**40L**
CSE 302	**Elective - V**	**L-T-P : 3-1-0**	**Credit: 4**	**40L**
CSE 311	**Advanced Computing Lab - II**	**L-T-P : 0-0-6**	**Credit: 4**	**60P**
CSE 321	**Thesis - I**	**L-T-P : 0-0-20**	**Credit: 12**	

Semester-IV

CSE 421	**Thesis - II**	**L-T-P : 0-0-24**	**Credit: 18**	
CSE 431	**Grand Viva**	**L-T-P : NA**	**Credit: 6**	

Elective Papers

Elective: IoT and Sensor Networks

Introduction to Sensor networks in smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security, IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints, hardware, Data representation and visualization, Interaction and remote control.
Exemplary Device Board, Linux on Raspberry, Interface and Programming & IoT Device. Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases
Industrial Automation-Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation
Applications: Smart Grid &IoT, Healthcare, Industry automation, Commercial building automation using IoT, Smart cities, recent trends in sensor network and IoT architecture.

Books:

1. Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publication

2. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things by Pearson Paperback – 16 Aug 2017 ,by Hanes David (Author), Salgueiro Gonzalo (Author), Grossetete Patrick (Author), Barton Rob (Author)

Elective: Machine Learning

Introduction; Learning Paradigms; Concept Learning.

Clustering methods, variants of K-means, hierarchical clustering, BIRCH, DBSCAN, Expectation-Maximization, Cluster Evaluation Techniques – Internal and External, clustering ensemble.
Linear Discriminant Analysis, Support Vector Machine, Naïve Bayes, Gradient Descent, Class Evaluation Measures, Overfitting, Bias Variance Trade-off Precision, Recall, F1 Score, ROC, AUC,Validation Strategies.
Neural Network, LTU, Perceptron, MLP, Activation Function, Loss Functions, Optimizers, Momentum Adadelta, RMSProp, Adam, Early Stopping, drop-out, Batch Normalization; Word Embedding, CboW,Skip-gram, Glove, ElMo, CNN, RNN, LSTM, GRU, Encoder-Decoder Network, Transfer, Auto Encoder, Generative Adversarial Network; Ensemble Methods - Bagging, Committee Machines andStacking, Ensemble Methods – Boosting, Gradient Boosting; Undirected Graphical Models, Markov Chains, Random walk Monte Carlo, HMM, Variable elimination, belief propagation, Introduction to Reinforcement Learning, Sampling-based techniques, Q Learning, Introduction to XAI, Lime, SHAP etc. Learning from online streaming data, Machine Learning Applications.

Books:

1. Machine Learning, Tom Mitchell, McGraw Hill, 1997.
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Second Edition. Feb 2009. Trevor Hastie, Robert Tibshirani, Jerome Friedman.
3. Introduction to Machine Learning, third edition. Ethem Alpaydin. The MIT Press. September 2014: ISBN: 978-0-262-028189

Elective: Theory of Computing

Concepts of structural program development; concept of data types; precedence and associatively of operators; conditional transfer; deterministic and in-deterministic loops; recursions; functions and procedures - call by value, call by reference and their differences; programming for numerical methods;records.
Data-type handling and various constructs (conditional, loop, functions etc); pointers: concept of pointers and passing parameters using pointers, non-numeric processing, concept of arrays of pointersand pointers to pointers; Structures and unions – advantage of using structures, concept of informationhiding, pointers to structures; Files - basic concept of various types of file access methods: sequential,indexed sequential, random, various statements for file handling
Advanced Programming Languages like C++, ADA, LISP, PROLOG, and PASCAL. Comparison ofvarious languages

Text Books:

1. Tennence W.Pratt, "Programming languages design and implementation", Prentice Hall of India.
2. Allen B. Tucker, "Programming Languages", Tata McGraw Hill.

Reference Books:

1. Gottfried BS – Programming with C, TMH pub.
2. Balagurusamy:ANSI C TMH

Elective: Pattern Recognition

Introduction - Definitions, data sets for Pattern Recognition, Different Paradigms of Pattern Recognition
Representations of Patterns and Classes Metric and non-metric proximity measures
Feature extraction, Different approaches to Feature SelectionNearest
Neighbor Classifier and variants
Efficient algorithms for nearest neighbour classification
Different Approaches to Prototype Selection
Bayes Classifier, Decision Trees, Linear Discriminant Function
Different Approaches to Prototype Selection, Bayes Classifier
Decision Trees, Linear Discriminant Function
Support Vector Machines, Clustering, Clustering Large datasets, Combination of Classifiers,Applications - Document Recognition.

Text Books:

1. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.

Reference Books:

1. Pattern Recognition Paperback by Narasimha Murthy and Susheela Devi
2. Pattern Recognition and Machine Learning (Information Science and Statistics) by Christopher Bishop

Elective: Artificial Intelligence

Introduction – What is AI – Importance of AI – objectives.
Intelligent agents, state space representation, uninformed searches – BFS, DFS, IDS, informed andheuristic searches – Branch & bound, Best first, A* search; Local searches
and optimization, local and global optima, hill climbing, gradient descent, simulated annealing, genetic algorithms, Adversarial Search: Min-Max game tree
Knowledge – Its representation, Organization – Manipulation and Acquisition.
Predicate calculus in AI – First order predicate logic & its use in knowledge representation-Resolutionprinciple. Use of resolution in reasoning and question answering.
Uncertainly Management-Fuzzy logic, Bayesian inferencing, dempster-shafer theory of beliefs, structured representation of knowledge- - Semantic networks, frames, conceptual dependency & scripts. Expert systems-rule based system architecture non-production system architecture-knowledge acquisition methods-Explanation methods-Expert system shells, Application of AI in natural language processing, speech understanding. Computer Vision, planning, etc.

Text Books:

1. George F. Luger, 'Artificial Intelligence – Structures and Strategies for Complex Problem Solving', Fourth Edition, Pearson Education, 2002.
2. Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence ,McGraw Hill Education (India) Private Limited; 3 edition

Reference Books:

1. Nils J. Nilsson, Principles of Artificial Intelligence (Symbolic Computation / Artificial Intelligence), Springer; Softcover reprint of the original 1st ed. 1982 edition
2. George F. Luger, Artificial Intelligence, Pearson Education; Fifth edition
3. Stuart Russell and Peter Norvig: Artifical Intelligence: A Modern Approach, Pearson; Third edition

Elective: Advanced Software Engineering

System Engineering - Analysis & Design
Software Architectures & Design.
Software Metrics.
Software Testing Strategies: Analytical models (e.g. Markov Chain Model, Probabilistic Models) Software Reliability: Analytical Models.Formal Methods in Software Engineering (e.g. Formal Specification Language)Software Re-use Re-engineering - reverse engineering.Real-timeime Software Engineering.
Client/Server Software Engineering. CASE tool design & implementation. Verification & Validation.
Object-oriented Software Engineering: OO-Analysis, OO-Design, OO-Testing, metrics for OO systems. System Modeling and Simulation.Software Engineering Economics.

Text Books:

1. Pressman: Software Engineering, McGraw Hill.
2. Shoeman: Software Engineering, McGraw Hill.
3. Ghezzi, Software Engineering, PHI

Reference Books:

1. Fundamentals of Software Engineering by Rajib Mall, PHI.
2. Sommerville, Ian – Software Engineering, Pearson Education

Elective: Advanced Network Security & TCP/IP Programming

Uniqueness – Number Theory concepts – Primality – Modular Arithmetic – Fermet & Euler Theorem –Euclid Algorithm – RSA – Elliptic Curve Cryptography – Diffie Hellman Key Exchange
Digests – Requirements – MAC – Hash function – Security of Hash and MAC – Birthday Attack –

MD5 – SHA – RIPEMD – Digital Signature Standard – Proof of DSSAuthentication applications – Kerberos – Kerberos Encryption Techniques – PGP – Radix64 – IP Security Architecture – Payload –Key management – Web security requirements – SSL – TLS – SET
Resources – Intruders and Intrusion – Viruses and Worms – OS Security – Firewalls – Design Principles – Packet Filtering – Application gateways – Trusted systems – Counter Measures Protocols and standards – OSI model – TCP / IP protocol suite – addressing – versions – underlyingtechnologies.
Classful addressing – other issues – subnetting – supernetting – classless addressing – routing methods – delivery – table and modules – CIDR – ARP package – RARP.
Datagram – fragmentation – options – checksum – IP package – ICMP – messages, formats – error reporting – query – checksum – ICMP package – IGMP – messages, operation – encapsulation – IGMPpackage – UDP – datagram – checksum – operation – uses – UDP package.
Services – flow, congestion and error control – TCP package and operation – state transition diagram – unicast routing protocols – RIP – OSPF – BGP – multicast routing – trees – protocols – MOSPF – CBT – PIM
Client server model – concurrency – processes – sockets – byte ordering – socket system calls – TCP and UDP client-server programs – BOOTP -DHCP – DNS – name space, resolution – types of records – concept – mode of operation – Rlogin.

Text Books:

1. "Network Security Essentials: Applications and Standards" by William Stallings, Pearson
2. "Network Security private communication in a public world", C. Kaufman, R. Perlman and M. Speciner,

Pearson

Reference Books:

1. "Cryptography and Network Security", William Stallings, 2nd Edition, Pearson Education Asia
2. "Designing Network Security", Merike Kaeo, 2nd Edition, Pearson Books
3. "Building Internet Firewalls", Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition, Oreilly
4. "Practical Unix & Internet Security", Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly

Elective: Blockchain Technology

Introduction of Cryptography and Blockchain: What is Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions And Blocks, P2P Systems, Keys As Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.
BitCoin and Cryptocurrency: What is Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain And Digital Currency, Transactional Blocks, Impact Of Blockchain Technology On Cryptocurrency.

Introduction to Ethereum: What is Ethereum, Introduction to Ethereum, Consensus Mechanisms, How Smart Contracts Work, Metamask Setup, Ethereum Accounts, Receiving Ether's What's a Transaction?,Smart Contracts.
Introduction to Hyperledger: What is Hyperledger? Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer.
Solidity Programming:
Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types (Int, Real, String, Bytes,Arrays, Mapping, Enum, address)
Blockchain Applications: Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

Reference Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19,2016).
2. Antonopoulos, Mastering Bitcoin.
3. Antonopoulos and G. Wood, Mastering Ethereum.
4. D. Drescher, Blockchain Basics. Apress, 2017.

Elective: Real Time & Embedded Systems

Real Time Systems, Specification, Analysis, Design. Definition, Types and Evolution; State Diagram,Finite Automata, Timed Petri Net, Formal Methods for Analysis & Design.
Algorithm Development, Implementation of Real Time Algorithms Debugging and Verification Real Time Distributed Computing
Clock Synchronization, Real Time constraint satisfaction Reliability & Safety.Case Studies Computer Control Systems Real Time Simulation Systems Mission Control Systems Safety Critical Systems.

Introduction: Characteristics of embedded systems; Applications; Concept of real time systems; Challenges in embedded system design.
Embedded Processors: Review of structure of a basic computer system: CPU, memory, I/O devices on a bus; Memory System Mechanisms – Caches, Memory Management Units and Address Translation; I/Osubsystem – input and output devices, busy-wait I/O, interrupt driven I/O; Interrupts – Basics, interrupt latency; Co-processors; Processor Performance Enhancement-Pipelining, Superscalar execution,caching.
The Embedded Computing Platform: Board Buses – Bus Arbitration and Timing; The CPU Bus; Memory Devices and their Characteristics – Random-Access memories, Read-Only memories; I/O devices – Timers and Counters, Watchdog timers, GPIO, A/D, D/A, Displays, Keyboards; Component Interfacing
– Memory interfacing, device interfacing, interfacing protocols; Designing with processors – System architecture, Hardware design; Target Devices-FPGA, CPLD.

Embedded Software Architectures: Round-Robin; Round-Robin with Interrupts; Function Queue- Scheduling Architectures; Real-Time Operating System Architecture; Selecting an Architecture.
Real-time operating systems: Tasks and Task States; Tasks and Data; Context Switching-Cooperative multitasking, Preemptive multitasking; Scheduling Policies-Rate-Monotonic scheduling, Earliest- Deadline-First scheduling, RMS versus EDF; Semaphores and Shared Data; Message Queues; Timer Functions; Events; Memory Management; Priority Inversion; Interrupt Routines in an RTOS Environment.
Low-power computing: Sources of energy consumption: toggling, leakage – Instruction-level nstrategies for power-management: functional unit management - Memory system power consumption: caches, off- chip memory - Power consumption with multiple processes – Systemlevel power management: deterministic, probabilistic methods.
Hardware Accelerators: CPUs and Accelerators – Why Accelerators, Accelerator Design; Accelerated System Design – Performance Analysis, System Architecture Framework, Partitioning, Scheduling and Allocation, System Integration and Debugging. Networked embedded systems: Why networked embedded systems - Example networked embedded systems: automobiles, factory automation systems - Types of network fabrics - Network performance analysis - Internet-enabled embedded systems.
Design and Development of Embedded Systems: Creating an Embedded System Architecture; Implementing the Design - Embedded Software Development Tools, Host and Target Machines, Linker/Loader for Embedded Software, Getting Embedded Software into Target System, Debugging Techniques and Tools, Testing on the host machine, instruction set simulators, oscilloscopes, logic analyzers, in-circuit emulators, monitors, System Boot-Up; Quality
Assurance and Testing of the Design.

Text Books:

1. Frank Vahid, Tony Givargis: Embedded System Design: A Unified Hardware/SoftwareIntroduction, Wiley; Student edition (21 July 2006)
2. Mazidi M. Ali , Mazidi J. G., and Rolin McKinlay, The 8051 Microcontroller and EmbeddedSystems; Pearson; Second edition (2008)
3. Real-time Systems, Jane W. S. Liu
4. Real-Time Systems Design and Analysis, Philip A. Laplante
5. Real-time Systems, Hermann Kopetz

Reference Books :

1. Wayne Wolf, Computers as Components: Principles of Embedded Computing SystemDesign, Morgan Kaufmann; 2 edition (June 16, 2008)
2. David E. Simon, Embedded Software Primer,, Addison-Wesley Professional; 1 edition(August 15, 1999)
3. Raj Kamal: Embedded Systems ; McGraw-Hill Education (India); 2nd Edition (March 9,2009)
4. Real-time Systems: Theory and practice, Rajib Mall
5. Real-Time Concepts for Embedded Systems, Caroline Yao, Li Zhang

Elective: Management Information Systems

Management activities, roles and levels Management Planning and Control: how planning and control systems interrelateStrategic Planning within an organization: activities, techniques and results The nature of decision-making: decision-making models and classification of decision-makingsituations.
Management as the direct user of an MIS vs Intermediary usage Measurement of MIS performance and capabilities,Reporting Systems (MRS) Decision Support Systems (DSS). Office Information Systems (OIS) – including video conferencing and email.Knowledge based systems that support management such as Expert Systems (ES) and Neural Network (NN) Systems.

The application of Online-Analytical Processing (OLAP)/Data Mining/Business Intelligence (BI) tools in supporting management decision making.

The relationships of MIS to other enterprise applications, such as Transaction Processing Systems(TPS) and Enterprise Resource Planning (ERP) systems
IS within functional areas such as Human Resources, Marketing and Sales, Production, Accounting andFinance, Customer Relationship Management (CRM), Product Supply Chain Management Systems The Internet and MIS provisions: Internet and the linkages to legacy MIS, Internet customer interfaces,security issues. MIS and mobile Computing, MIS and social media.

Text Books:

1. Kenneth C. Laudon & Jane P. Laudon, Essentials of Management Information Systems, TenthEdition, Pearson Prentice-Hall, 2012
2. Terry Lucy, Management Information Systems, Ninth Edition, 2005, Thompson

Reference Books:

1. McNurlin, Sprague & Bui, Information Systems Management in Practice, Prentice-Hall (8th Ed),2013
2. Efraim Turban, Jay Aronson & Tin-Peng Liang, Decision Support Systems and Intelligent Systems,Ninth Internal Edition, Pearson Prentice Hall, 2010.

Elective: Optical Networks

Introduction to Optical Networks Components, Transmitters, Transmission System Engineering First Generation Networks Wavelength Routing Networks Virtual Topology Design, Access Networks.

Text Books:

1. Optical networks: A practical perspective, Kumar Sivarajan and Rajiv Ramaswamy: MorganKauffman 1998.
2. Gigabit-capable Passive Optical Networks-D. Hood, Wiley

Reference Books:

1. Optical Communication Networks: Biswajit Mukherjee: TMG,1998.
2. Optical Networks, Ulysees Black: Pearson education 2007.

Elective: Cloud Computing

Introduction to cloud computing – Overview of Computing, Cloud Computing NIST Model, Properties,characteristics and disadvantages, role of open standards.
Cloud computing architecture – cloud computing stack, service Models (XaaS), IaaS, Paas, SaaS, Daas,Deployment Models, private, public, hybrid, commercial cloud models.
Service management in Cloud computing – service level agreement (SLA), SLA violation, cloud economics.
Resource management in cloud computing – resource sharing, scalability, elasticity, transparency. Data management in cloud computing – looking at data scalability and cloud services, database anddata stores in cloud, large scale data processing
Cloud security – infrastructure security, data security and storage, identity and access management,access control, trust, reputation risk
Cloud simulators – CloudSim, CloudAnalyst, MultiRecCloudSim, CloudSimPlus,GreenCloudSimulator
Research trend in Cloud compting, green cloud computing, fog computing

Text Books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013
2. Mastering Cloud Computing by RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, McGrawHill
3. Education (India) Private Limited, 2013

Reference Books:

1. Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill
2. Cloud Computing, Miller, Pearson
3. Building applications in cloud:Concept, Patterns and Projects, Moyer, Pearson

Elective: Network Administration

Networking Overview • IP Addressing Basics • Active Directory • DHCP, DNS, FTP, HTTP etc. •Implementing and Managing WINS • Securing Network Traffic • Remote Access • Internet Authentication Service • Routing • Other related topics

Textbooks:

1. Hands-on Microsoft Windows Server 2003 Administration by Dan DiNicolo, Thomson CourseTechnology, ISBN: 0619186119;

2. MCSE Guide to Managing a Microsoft Windows Server 2003 Network, Enhanced by Jason W.Eckert and M. John Schitka, Thomson Course Technology, ISBN: 0619217537

Elective: High Performance Computing Architecture

Parallel Processing Concepts (Quick Overview): Levels of parallelism (instruction, transaction, task, thread, memory, function). Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation etc). Architectures: N-wide superscalar architectures, multi-core, multi-threaded

Parallel Programming with CUDA: Processor Architecture, Interconnect, Communication, Memory Organization, and Programming Models in high performance computing architectures: (Examples: IBMCELL BE, Nvidia Tesla GPU, Intel Larrabee Microarchitecture and Intel Nehalem microarchitecture). Memory hierarchy and transaction specific memory design. Thread Organization

Fundamental Design Issues in Parallel Computing: Synchronization. Scheduling. Job Allocation. Job Partitioning. Dependency Analysis. Mapping Parallel Algorithms onto Parallel Architectures. Performance Analysis of Parallel Algorithms.

Fundamental Limitations Facing Parallel Computing: Bandwidth Limitations. Latency Limitations. Latency Hiding/Tolerating Techniques and their limitations

Power-Aware Computing and Communication: Power-aware Processing Techniques. Power-awareMemory Design. Power-aware Interconnect Design. Software Power Management

Advanced Topics: Petascale Computing. Optics in Parallel Computing. Quantum Computers. Recent developments in Nanotechnology and its impact on HPC

Reference Books:

1. "Highly Parallel Computing", by George S. Almasi and Alan Gottlieb
2. "Advanced Computer Architecture: Parallelism, Scalability, Programmability", by Kai Hwang,McGraw Hill 1993.
3. "Parallel Computer Architecture: A hardware/Software Approach", by David Culler JaswinderPal Singh, Morgan Kaufmann, 1999.
4. "Scalable Parallel Computing", by Kai Hwang, McGraw Hill 1998.
5. "Principles and Practices on Interconnection Networks", by William James Dally and BrianTowles, Morgan Kauffman 2004.
6. GPU Gems 3 --- by Hubert Nguyen (Chapter 29 to Chapter 41).
7. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, and VipinKumar, 2nd edition, Addison-Welsey, © 2003.
8. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.),

Elective: Web Mining and Internet Technology

Data integration for e-commerce, Web personalization and recommender systems, Web content and structure mining, Web data warehousing, Review of tools, applications, and systems, Data collection and sources of data, Data preparation for usage mining, Mining navigational patterns, Integrating e- commerce data, Leveraging site content and structure, User tracking and profiling, E-Metrics: measuring success in e-commerce, Privacy issues, Evolution of the Internet, Growth of the World WideWeb and Big Data, Client-server model, Architecture of the Intranet/Internet/Extranet, Access method: dialup, ISDN, ADSL/2+, cable, LAN, WiFi, Mobile and Satellite, Proxy Servers, Application areas: E- commerce, Education, Entertainment such as Games and Gambling
Internet of Things (IoT) Search Engines, Webbots, integrity of information, database online.

Text Books:

1. Presten Gralla and Michael Troller., How the Internet Works, Que, (8th Edition), 2006
2. Perry J. et al, The Internet – Illustrated Introductory, Course Technology (3rd Ed)
3. Bates, C., Web Programming: Building Internet Applications, John Wiley and Sons (3rd Ed), 2006.
4. Berners-Lee, T. et al, Weaving the Web, Harper Business, 2000

Reference Books:

1. Hofstetter, F.T., Internet Literacy, McGraw Hill (4th Ed), 2005
2. McGloughlin, S., Multimedia: Concepts and Practice, Prentice Hall, 2001.
3. Anderson, P., Web 2.0 and Beyond: Principles and Technologies, Chapman & Hall/CRC Textbooksin Computing, 2012
4. Bahga, A and Madisetti, V., Internet of Things: A Hands-On Approach, VPT, 2014

Elective: Authentication & Steganography

Introduction to Biometrics: Introduction, Physiological or Behavioral, Verification vs. Identification,Applications, Biometrics Technologies, Working of Biometrics, Benefits, Application Design.

Fingerprint Recognition: What Is Fingerprint Scanning? Practical Applications for Fingerprint Scanning, Accuracy and Integrity, Fingerprint Matching, Fingerprint Classification, Fingerprint Image Enhancement, Fingerprint Feature Extraction, Fingerprint Form Factors, Types of Scanners: Optical - Silicon – Ultrasound, Fingerprint Matching.
Speaker Recognition: Algorithms for training, recognition and adaptation to speaker and transmission channel, mainly based on Hidden Markov Models (HMM), methods for reducing the sensitivity to external noise and distortion, acoustic modeling of static and time-varying spectral properties of speech,statistic modeling of language in spontaneous speech and written text, specific analysis and decision techniques for speaker recognition.
Face Recognition: Introduction to Face Recognition, How is Face Recognition Technology Currently Being Used? How Well Does Face Recognition Work, Why Face Recognition, Face Recognition: Howit Works, Image Quality, Facial Scan Process Flow, Verification vs. Identification, Primary Facial Recognition Technologies, Facial Recognition Applications.

Multi-Modal Biometrics: Introduction to Multi-Modal Biometric Systems, Fusion Methodology, Levels of Fusion, Feature-Extraction Level Fusion, Data-Matching Level Fusion, Probabilistic-Decision level Fusion, Fusion Procedure, Modes ofOperation, Integration Strategies, Issues, Soft Biometrics, A Biometric Vision.

Text Books:

1. Guide to Biometrics (Springer Professional Computing) by R. Bolle, J. Connell, S. Pankanti, N.Ratha, Springer Press, 2003, ISBN0387400893
2. Biometrics Personal Identification in Networked Society, Jain, Bolle, Pankanti 1999
3. Handbook of Fingerprint Recognition, Maltoni, Maio, Jain, Prabhakar, 2005
4. Biometric Systems, Wayman, Jain, Maltoni and Maio 2004

Reference Books:

1. Fundamentals of Speech Recognition, L. Rabiner and B. Juang, , Pearson Education.
2. Speech and Audio Signal Processing, B. Gold and N. Morgan, John Wiley.
3. Spoken Language Processing, Huang, Acero & Hon, Prentice Hall, 2001.
4. Speech and Language Processing: An Intro to NLP, CL, and Speech Recognition (2nd Edition)Jurafsky & Martin, Prentice Hall, 2000.
5. Statistical Methods for Speech Recognition. Jelinek. MIT Press,
6. Fundamentals of Speech Recognition, Rabiner & Juang, Prentice-Hall,

Elective: Data Warehousing and Data Mining

Data Warehousing and Business Analysis: - Data warehousing Components –Building a Data warehouse
–Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.
Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration andTransformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems.
Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based AssociationMining.
Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model- Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.
Classification and Prediction: - Issues Regarding Classification and Prediction – Nearest Neighbour Classification - Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification –Support Vector Machines – Associative Classification –Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section. Mining Object, Spatial, Multimedia, Text and Web Data:
Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

Books:

1. Reema Thareja, “Data Warehousing”, Oxford University Press.
2. Jiawei Han and Micheline Kamber, “Data Mining Concepts & Techniques”, Elsevier Pub.
3. Margret H. Dunham “Data Mining: Introductory and Advanced topics” Pearson Education
4. Paulraj Ponniah, “Data Warehousing Fundamentals”, John Wiley & Sons, Inc.
5. Vikram Pudi, P. Radha Krishana “Data Mining”, Oxford University press.

Elective: Digital Image Processing

Introduction: Digital Image representation; Fundamental steps in Image processing, Elements of digitalImage processing systems.
Digital Image Fundamentals: Sampling and quantization, imaging geometry.
Image Transforms: Fourier, Walsh, Hademord, discrete cosine and Hotelling transforms and theirproperties.
Image Enhancement: Enhancement by point processing, spatial filtering, Frequency domainenhancement, Color image processing.
Image Restoration: Unconstrained and constraint restoring, inverse filtering, Wiener Filter, Geometrictransforms.
Image Compression: Image Compression models, Error-free compression, Lossy compression, Imagecompression standards.
Image Segmentation: Detection of discontinuities, edge linking, Thresholding.
Representations and Descriptions: Chain codes, shape numbers, moments and Fourier and other descriptors. Recognition & Interpretations.

Text Book:

1. Digital Image Processing, Gonzalves,Pearson
2. Digital Image Processing, Jahne, Springer India
3. Digital Image Processing &Analysis,Chanda&Majumder,PHI
4. Fundamentals of Digital Image Processing, Jain, PHI

References Books:

1. Image Processing, Analysis & Machine Vision, Sonka, VIKAS
2. Getting Started with GIS- Clarke Keith. C; PE.
3. Concepts & Techniques of GIS - Lo C.P, Albert, Yeung K.W- PHI.

Department of Computer Science and Engineering
UNIVERSITY OF KALYANI, KALYANI 741235
WEST BENGAL

SYLLABUS

FOR

MASTER OF COMPUTER APPLICATIONS
(MCA)
(Two-Year Programme)

As per
AICTE MODEL CURRICULUM
(Effective from the Session: 2021-22)

MCA:
Paper Code Convention: MCA – XYZ

[X = 1/2/3/4 (semester), Y = 0/1/2/3/4 (theory/practical/project/viva/bridge course), Z (paper id)]

Paper Code	Paper Name	Type	Credit	Weekly hours (L+T+P)	Marks Theory - (Exam+IA) Practical - (Exam+Assignment+Viva) Project – (Report+Presentation+Viva) Bridge (Theory exam+IA+Lab exam)
Semester - I					
MCA–101	Mathematical Foundation	Theory	4	3+1+0	100 (70+30)
MCA–102	Data and File Structures	Theory	4	3+1+0	100 (70+30)
MCA–103	Computer Organization and Architecture	Theory	4	3+1+0	100 (70+30)
MCA–104	Database Management Systems	Theory	4	3+1+0	100 (70+30)
MCA–105	Operating Systems	Theory	4	3+1+0	100 (70+30)
MCA–106	Introduction to Management Functions	Theory	2	1+1+0	50 (40+10)
MCA–111	Communicative English and Business Presentation	Practical	2	0+0+2	50
MCA–112	Data and File Structures Laboratory with C	Practical	3	0+0+3	100
MCA–113	Digital Circuits and Computer Organization Laboratory	Practical	3	0+0+3	100
MCA–114	Database Management Systems Laboratory	Practical	3	0+0+3	100
MCA–141*	Introduction to Computing and C Programming	Bridge Course	--	2+0+2	100 ((40+10)+50)
TOTAL			33	33	900
*The bridge course is a mandatory non-credit course for the students without having computer science/application background. The students opting for this course must qualify/pass in order to complete the MCA degree.					
Semester - II					
MCA–201	Design and Analysis of Algorithms	Theory	4	3+1+0	100 (70+30)
MCA–202	Scientific Computing	Theory	4	3+1+0	100 (70+30)
MCA–203	Object Oriented Programming	Theory	4	3+1+0	100 (70+30)
MCA–204	Artificial Intelligence	Theory	4	3+1+0	100 (70+30)
MCA–205	Introduction to Data Analytics	Theory	4	3+1+0	100 (70+30)
MCA–211	Object Oriented Programming Laboratory	Practical	3	0+0+3	100
MCA–212	AI and Data Analytics Laboratory	Practical	3	0+0+3	100
MCA–213	Scientific Computing Laboratory	Practical	3	0+0+3	100
MCA–214	Advanced Programming Laboratory–I	Practical	3	0+0+3	100
TOTAL			32	32	900
Semester - III					
MCA–301	Microprocessor and Its Applications	Theory	4	3+1+0	100 (70+30)
MCA–302	Computer Networks	Theory	4	3+1+0	100 (70+30)
MCA–303	Software Engineering	Theory	4	3+1+0	100 (70+30)
MCA–304	Elective – I	Theory	4	3+1+0	100 (70+30)
MCA–305	Elective – II	Theory	4	3+1+0	100 (70+30)
MCA-306	Elective – III	Theory	4	3+1+0	100 (70+30)
MCA–311	Microprocessor Laboratory	Practical	3	0+0+3	100
MCA–312	Web-based Programming Laboratory	Practical	3	0+0+3	100
MCA–313	Advanced Programming Laboratory–II	Practical	3	0+0+3	100
MCA–321	Project–I	Project	3	0+0+3	100
TOTAL			36	36	1000
Semester - IV					
MCA – 421	Project–II	Project	16	0+0+24	400
MCA – 431	Grand Viva	Viva	8	-	200
TOTAL			24	24	600
Overall Total			125	125	3400

Electives 1. Computer Graphics 2. MCA-E/02 Pattern Recognitions 3. MCA-E/03 Soft Computing 4. MCA-E/04 Advanced DBMS 5. MCA-E/05 Embedded System Design 6. MCA-E/06 Simulation & Modeling 7. MCA-E/07 Mobile Computing 8. MCA-E/08 Parallel Processing 9. MCA-E/09 IoT and Sensor Networks 10. MCA-E/10 Digital Image Processing 11. MCA-E/11 Managerial Economics 12. MCA-E/12 Computational Geometry 13. MCA-E/13 Data Mining 14. MCA-E/14 Distributed Computing 15. MCA-E/15 Graph Algorithm 16. MCA-E/16 VLSI Design	17. MCA-E/17 Numerical & Statistical Computing 18. MCA-E/18 Advance Data Structure 19. MCA-E/19 Network Programming 20. MCA-E/20 Remote Sensing & GIS Applications 21. MCA-E/21 Network Security 22. MCA-E/22 Real Time Systems 23. MCA-E/23 Multicriteria Decision Making 24. MCA-E/24 Computer Communication Principles 25. MCA-E/25 Managerial Accounting 26. MCA-E/26 Formal Language & Automata Theory 27. MCA-E/27 Compiler Design 28. MCA-E/28 E-Commerce 29. MCA-E/29 Values & Professional Ethics 30. MCA-E/30 Cloud Computing 31. MCA-E/31 Computational Biology 32. MCA-E/32 Big Data Analytics

MCA Part I 1st Semester

MCA–101. Mathematical Foundation
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Functions and Relations: Definition and type of functions, mappings, injection, bijection and surjection, equivalence relations and partitions, partial ordering relation, Lattices and their applications, generating functions, recurrence relations, solution of linear homogeneous and non- homogeneous recurrence relations by the method of generating functions and particular solution method.
Algebraic Structures: Groups, Rings and Fields, Group Codes, Concepts of Vector Spaces.
Probability: Sample space, Events, Axioms, Conditional probability, Bayes' rule, Random variables: Discrete and continuous, Distribution and density functions, Marginal and conditional distributions, Binomial distribution, Poisson distribution, Normal distribution, Stochastic independence.
Statistical Methods: Sampling, Frequency Distribution. Measures of Central Tendency and Dispersion, Moments, Discrete Distribution Binomial and Poisson Distribution, Regression Analysis/Curve Fitting, Correlation Co-Efficient, Multiple, Partial and Rank Correlations, Tests of Significance- X Test, T-Test and F-Test.
Mathematical/Propositional Logic: Mathematical reasoning, Proposition, First order logic, Basic logical operations, Tautologies, Contradictions, connectives, conditionals and bi-conditionals, well-formed formulas, equivalence of formulas, Algebra of Proposition, Logical implication, Logical equivalence, duality law, Normal forms, Inference Theory for propositional calculus, Predicates, quantifiers, free and bound variables, inference theory of predicate calculus.

Reference Books:

1. Narsingh Deo, Graph Theory With Applications To Engineering And Computer Science, PHI Learning
2. C. L. Liu, Elements of Discrete Mathematics, TMH, 2000.
3. Kenneth H. Rosen; Discrete Mathematics and its applications; TMH.

4. K. H. Rosen, Discrete Mathematics and applications, fifth edition 2003, TMH.
5. Ross, S., A First Course in Probability, Collier Macmillan, New York, 1976
6. Liu, C.L., Introduction to Combinatorial Mathematics, McGraw Hill. 1996
7. R.P. Grimaldi, B. V. Ramana, Discrete and Combinatorial mathematics: An applied introduction, Pearson Education, 2007
8. Murray, R., J. Spiegel, and R. Schiller. Schaum's outline of probability and statistics. 2013.
9. Lipschutz, Seymour, and Marc Lars Lipson. Discrete mathematics. McGraw-Hili, 2007.

MCA–102. Data and File Structures
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Data Types and Algorithms: Time and Space Analysis Of Algorithms-Order Natations: Linear Data Structures: Sequential Storage Representation-Arrays, Strings, Stacks, Queues, Dequeues and other their Applications: Linear Data Structures: Linked Storage Lists, Circularly Linked Lists, Doubly Linked Lists, Applications: Recursion-Design of Recursive Algorithms, Tail Recursion, When Not to use Recursion, Removal of Recursion; Non-Linear Data Structures: Trees, Binary Trees, Binary Search Tree, Traversals and Threads, Insertion and Deletion Algorithms, Height-Balanced and Weight-Balanced Trees, B-Trees, B+ Trees, Applications of Trees: Graphs-Representation, Sorting and Searching-Review of Various Algorithms, Hashing.

Text Books:

1. Ellis Horowitz, S. Sahni, D. Mehta Fundamentals of Data Structures in C++, Galgotia Book Source, New Delhi.
2. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms (2nd ed.), Prentice-Hall of India, 2006
3. Y. Langsam, M. Augenstin and A. Tannenbaum, Data Structures using C and C++, Pearson Education Asia, 2nd Edition, 2002.
4. Aho Alfred V., Hopperoft John E., UIlman Jeffrey D., "Data Structures and Algorithms", Addison

Wesley

Reference Books:

1. 1 Debasis Samanta, Classic Data Structures, PHI, 2nd Edition
2. S. Lipschutz, Data Structures Mc-Graw Hill International Editions, 1986.
3. Jean-Paul Tremblay, Paul. G. Soresan, An introduction to data structures with Applications, Tata Mc-Graw Hill International Editions, 2nd edition, 1984.
4. A. Michael Berman, Data structures via C++, Oxford University Press, 2002.
5. M. Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education, 2002, 2nd edition.
6. M.T. Goodrich, R. Tamassia and D. Mount, Data Structures and Algorithms in C++, John Wiley & Sons, Inc., 2004.
7. M.J. Folk, B. Zoellick and G. Riccardi, File Structures: An Object Oriented Approach With C++ (3rd ed.), Addison- Wesley, 1997.
8. Robert L. Kruse and A.J. Ryba, Data structures and program design in C++, Prentice-Hall, Inc., NJ, 1998.
9. B. Stroupstrup, The C++ Programming Language, Addison Wesley, 2004.
10. D.E.Knuth, Fundamental Algorithms, Vol. I, Addison Wesley, 1997.

MCA–103. Computer Organization and Architecture
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Fixed point Arithmetic: Arithmetic and logical operations of signed numbers and their implementation, Concepts of floating point numbers and operations, Bit-slice processors and Emulation

Principles of Computer design: Basic concepts, Instruction Set Architecture, Hardware System Architecture, Classifications of Computer Architecture: von Neumann's classification, Flynn's classification, Machine language instructions, Instruction formats, Instruction cycle and execution cycle, sequencing, Addressing modes, instruction types, Instruction set selection, Stacks, Queues, Subroutines (Example instruction set may be used: INTEL/ARM/MOTOROLA/others),

Register Transfer and Micro Operation: Register Transfer Language, Bus and Memory Transfers, Bus Architecture, Arithmetic Logic, Shift Microoperation, Arithmetic Logic Shift Unit, Design of Fast adders, Arithmetic Algorithms (addition, subtraction, Booth Multiplication).

Hardwired Control: Concepts, Data path and control path design, Fetching and storing word from/in main memory, Register transfers, Operations, execution of a complete instruction Hardwired control

Micro-programmed control: outline of microprogrammed control organization, control word, microprogram, next address generator (sequencer), control address register, control memory and control data register, advantages over hardwired control, address sequencing, mapping and associated hardware.

RISC Vs CISC, Pipelining in CPU design, Superscalar processors, Concepts of pipelining

I/O organization: Input-output processing, bus interface, Programmed data transfer; I/O interrupts-advantage over programmed transfer, DMA transfer, Performance evaluation - SPEC marks, Transaction Processing benchmarks.

Memory: Basic concepts, memory system, storage technologies, memory array organization, RAM, ROM – different types, characteristics, cache memories, memory hierarchy, virtual memory, address translation, secondary memories, interleaving, cache and virtual memories and architectural aids to implement these, input-output devices and characteristics.

References:

1. Mano, M, Computer System and Architecture, (3rd Ed.), PHI, 1994
2. Pal Chauduri, P., Computer Organisation and Design, PHI, 1994
3. Pranab Chakraborthy, Computer Organization and Architecture, Universities Press.
4. Rajaraman,V., and Radhakrishnan, T., Introduction to Digital Computer Design" (4th Ed.), PHI, 1997
5. Stallings. W, Computer Organization and Architecture, 2nd Ed., PHI,
6. C. Hamacher, Z. Vranesik, S. Zaky , Computer Organization, McGraw Hill
7. John P. Hayes, Computer Architecture and Organization, McGraw Hill
8. Tannenbaum, Structured Computer Organization, PHI Vravice, Zaky & Hamacher, Computer Organization, TMH

MCA–104. Database Management Systems
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction: Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Entity-Relationship Model: Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

Relational Model: Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations,

Views, Modifications of the Database.

SQL and Integrity Constraints: Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested

Subqueries, Database security application development using SQL, Stored procedures and triggers.
Relational Database Design: Functional Dependency, Different anamolies in designing a Database., Normalization using funtional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Nomalization using multi-valued depedencies, 4NF, 5NF.
Internals of RDBMS: Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols, two phase locking.
File Organization & Index Structures: File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree.

Text Books:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.
3. Ramakrishnan: Database Management System, McGraw-Hill
4. Gray Jim and Reuter Address, "Transaction Processing: Concepts and Techniques", Moragan Kauffman
Publishers.
5. Jain: Advanced Database Management System Cyber Tech
6. Date C. J., "Introduction to Database Management", Vol. I, II, III, Addison Wesley.
7. Ullman JD., "Principles of Database Systems", Galgottia Publication.

Reference Books:

1. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
2. "Fundamentals of Database Systems", Ramez Elmasri, Shamkant B. Navathe, Addison Wesley Publishing
Edition
3. "Database Management Systems", Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill

MCA–105. Operating Systems
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction: Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-programmed, time-sharing, real-time, distributed, parallel.
System Structure: Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, system calls.
Process Management:
Processes: Concept of processes, process scheduling, operations on processes, co-operating processes, interprocess communication.
Threads: overview, benefits of threads, user and kernel threads.
CPU scheduling: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling.
Process Synchronization: background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.
Deadlocks: system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.
Storage Management:
Memory Management: background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.

Virtual Memory: background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing.
File Systems: file concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, and indexed), and free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance.
I/O Management: I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and nonblocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.
Disk Management: Disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN) , disk reliability, disk formatting, boot block, bad blocks.
Protection & Security: Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.

Text Books:
1. Milenkovie M., "Operating System: Concept & Design", McGraw Hill.
2. Tanenbaum A.S., "Operating System Design & Implementation", Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., "Operating System Concepts", Wiley.
4. Dhamdhere: Operating System TMH

Reference Books:
1. Stalling, William, "Operating Systems", Maxwell McMillan International Editions, 1992.
2. Dietel H. N., "An Introduction to Operating Systems", Addison Wesley.

MCA–106. Introduction to Management Functions
Full Marks: 50, Weekly Hours: 1 + 1 + 0
Allotted Hrs: 20L

Accountancy- Its origin and scope, fundamental principal of double entry system single entry system, books of original entry and prime entry, cash book and its different uses, Trial Balance, Preparation of final account and Balance sheet , Accounting for noon-trading concerns.
Financial Management: Discipline and scope of Finance as distinct from accountancy, analysis of the Profit and Loss A/C and Balance Sheet, including Ratio Analysis and their implication. Fund Flow Statement. Business Budget & its control. Concept of cost and method costing their application, (IT Act)

Text Books:
1. Financial Management and Accounting - P. K. Jain, S. Chand & Co.
2. Management & Accounting: Principles and Practice - R. K. Sharma & Shashi Kumar Gupta, Kalyani Publishers.
3. Advanced Management Accounting - Kaplan & Atkinson, PHI.
4. Fundamentals of Financial Management - Van Home, PE.

Reference Books:
1. Financial Mgmt Accounting, Gupta,Pearson
2. Financial Mgmt, I.M. Pandey, Vikas
3. Financial Mgmt., Khan & Jain, TMH
4. Financial Mgmt ,Mcmenamin, OUP
5. Financial Mgmt& Policy, Van Horne, PHI
6. Financial Mgmt,Kulkarni&Satyaprasad, Himalaya

MCA–111. Communicative English and Business Presentation

Full Marks: 50, Weekly Hours: 0 + 0 + 2
Allotted Hrs: 20L
This should cover general and technical writing, oral communication and listening skills: letter writing, technical report writing, and business communication.
Expression: Practical communication skill development, business presentation with multimedia, speaking skill, prepared speech, extempore speech.

MCA–112. Data and File Structures Laboratory with C
Full Marks: 100, Weekly Hours: 0 + 0 + 3
Allotted Hrs: 40P
Lab pertaining to MCA-102

MCA–112. Digital Circuits and Computer Organization Laboratory
Full Marks: 100, Weekly Hours: 0 + 0 + 3
Allotted Hrs: 40P
Lab pertaining to MCA-103

MCA–112. Database Management Systems Laboratory
Full Marks: 100, Weekly Hours: 0 + 0 + 3
Allotted Hrs: 40P
Lab pertaining to MCA-104

MCA–141. Introduction to Computing and C Programming
Full Marks: 100, Weekly Hours: 2 + 0 + 2
Allotted Hrs: 20L, 20P
Introduction to computers and operating environment, Program development cycle.
Algorithm – Representations of Algorithm, Pseudocode, Flowcharts
Programming Languages, Introduction to C, Data representation and data types
Control Structures - Conditional execution and transfers, repetitions
Subprograms- Functions, procedures, parameter passing
String processing, Structures and enumerated data types - Arrays, lists, stacks.
Records and set, Files, Pointers
Recursion, Structured Programming

Text Books:
1. TennenceW.Pratt, “Programming languages design and implementation”, Prentice Hall of India.
2. Allen B. Tucker, “Programming Languages”, Tata McGraw Hill.
3. Gottfried BS – Programming with C, TMH pub.
4. Balagurusamy:ANSI C TMH
5. Kanetkar, Yashvant – Understanding Pointers in C- 2nd Edn. BPB
5. Kanetkar, Yashvant - Let us C. - 3rd revised Edn. BPB

Reference Books:
1. Roosta- Foundation of Programming Languages,Vikas
2. Jeyapoovan- A First Course in Prog with C, Vikas
3. Programming In C++, Y.I. Shah and M.H. Thaker, ISTE/EXCEL BOOKS
4. Fundamentals of Programming Languages, R. Bangia,Cyber Tech

MCA Part I 2nd Semester

MCA–201. Design and Analysis of Algorithms
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Basic concepts – complexity measures, worst and average case, upper and lower bounds. Algorithm design principles – divide and conquer, recursion, greedy method, dynamic programming.
Bounds for selecting and sorting – finding maximum, finding minimum and quick sort, radix sort.
Union – Find algorithms
Graph algorithms – Breadth first search, depth first search, topological sort, connected and biconnected components, Minimum spanning trees – Kruskal's and Prim's, shortest paths – Dijkstra's, Bellman-Ford's and Floyd-Warshall's.
Algebraic algorithms – evaluation of polynomials, Strassen's matrix multiplication.
Pattern matching algorithms.

Text Books:

1. U. Manber: Introduction to Algorithms
2. T. Cormen, C. Leiserson and R. Rivest: Introduction to Algorithms
3. Randomised algorithms by R. Motwani & P. Raghavan, Cambridge University Press, 1995, ISBN 0-521-47465-5.

Reference Books:

1. 1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Indtroduction to Algoritms, PHI, 2006
2. E. Horowitz, S. Sahni and S. Rajasekaran, Computer Algorithms/C++, Universities Press.
3. J. Kleinberg and E.Tardos, Algorithms Design, Pearson Education, 2006
4. S.Baase, Computer algorithms: Introduction to Design and Analysis, Addison Wesley, 1999
5. A.V. Levitin, Introduction to the Design and Analysis of algorithms, Pearson Education, 2006
6. R. Motwani and P. Raghavan, Randomized Algorithms, Cambridge University Press, 1995
7. Teofilo F.Gonzalez, Handbook of NP-Completeness: Theory and Applications, Chapman & Hall, 2009
8. Vijay V. Vazirani, Approximation Algorithms, Springer-Verlag, France, 2006
9. S. Rajasekharan and John Reif, Handbook of Parallel Computing: Models,algorithms and applications, Chapman and Hall/CRC, 2007
10. Gareth A. Jones and Josephine M. Jones, Elementary Number Theory, Springer, 1998

1995.

MCA–202. Scientific Computing
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

MCA–203. Object Oriented Programming
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

History of the development of object-oriented programming languages, object-attributes and methods,

message passing, Classes: Notion of abstraction, encapsulation/information hiding and modularity, Instantiation and initialization of objects: Constructors and destructor, Class hierarchy: single, multilevel, multiple and repeated inheritance, polymorphism, Object hierarchy – Aggregation; Advantages and disadvantages of object-oriented programming language, Features of C++.

Text Books:
1. Jana, C++ & Object Oriented Programming, PHI
2. Folk M. J.,Zoellick B., Riccard G., File Structures: An Object-Oriented Approach with C++

Reference Books:
1. Herbert Schild: The Complete Reference to C++, Osborne McGrawHill. McGraw Hill Education (India) Private Limited; 4 edition
2. Bjarne Stroustrup: Programming: Principles and Practice Using C++, Addison Wesley; 2 edition
3. James R Rumbaugh, Michael R. Blaha, William Lorensen, Frederick Eddy, William Premerlani. : Object Oriented Modeling and Design, Prentice Hall; 1 edition

MCA–204. Artificial Intelligence
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction – What is AI – Importance of AI – objectives.
Introduction to LISP and PROLOG.
Knowledge – Its representation, Organization – Manipulation and Acquisition.
Predicate calculus in AI – First order predicate logic & its use in knowledge representation-Resolution principle. Use of resolution in reasoning and question answering. Production systems and search strategies production system and its variants-Heuristic search methods, AND/OR Graphs and AO Algorithm. Searching Game Tree.
Uncertainly Management-Fuzzy logic, Bayesian inferencing, dempster-shafer theory of beliefs, structured representation of knowledge- - Semantic networks, frames, conceptual dependency & scripts. Expert systems-rule based system architecture non-production system architecture-knowledge acquisition methods-Explanation methods-Expert system shells, Application of AI in natural language processing, speech understanding. Computer Vision, planning, etc.

Text Books:
1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP
5. Logic & Prolog Programming, Saroj Kaushik, New Age International

Reference Books:
1. Expert Systems, Giarranto, VIKAS
2. Artificial Intelligence, Russel, Pearson

MCA–205. Introduction to Data Analytics
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction to Data Science, type of data, data collection, blending and preparation, data preprocessing, data storage and warehousing, ETL techniques, data mining, exploratory data analysis, statistical hypothesis testing, data science project life cycle, data visualization, introduction to unsupervised and supervised learning, clustering, K-means, hierarchical clustering, density-based clustering, association

rule mining, apriori algorithm, frequent pattern mining, regression, linear regression, classification, logistic regression, k-nn, decision tree, Bayesian learning dimensionality reduction, PCA, feature selection, graph data analysis, introduction to big data analytics, data science applications.
Statistical Decision Theory - Regression, Statistical Decision Theory - Classification, Bias Variance, Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Partial Least squares, Logistic Regression, LDA, Perceptron, Support Vector Machine, Neural Networks - Introduction, Early Models, Perceptron Learning, Backpropagation, Neural Networks - Initialization, Training & Validation, Parameter Estimation, Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL, Ensemble Methods - Bagging, Committee Machines and Stacking, Ensemble Methods – Boosting, Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks, Undirected Graphical Models, Markov Chains, HMM, Variable elimination, belief propagation, Clustering, Advanced techniques, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering, Gaussian Mixture Models, Expectation Maximization, Learning Theory, Introduction to Reinforcement Learning, Machine Learning Applications.

Text Books:

1. Cady, Field. The data science handbook. John Wiley & Sons, 2017.
2. J. Han and M. Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann/Elsevier India, 2001.
3. Tom Mitchell, Machine Learning, McGraw Hill, 1997.
4. Duda, Richard O., Peter E. Hart, and David G. Stork. Pattern classification. John Wiley & Sons, 2012.

Reference Books:

1. Alpaydin, Ethem. Introduction to machine learning. MIT press, 2009.
2. Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. The elements of statistical learning. Vol. 1. No. 10. New York: Springer series in statistics, 2001.
3. D. Hand, H. Mannila, and P. Smyth. Principles of Data Mining, MIT Press, 2001.
4. Pujari, Arun K. Data mining techniques. Universities press, 2001.

MCA–211. Object Oriented Programming Laboratory

Full Marks: 100, Weekly Hours: 0 + 0 + 3
Allotted Hrs: 40P
Lab pertaining to MCA-203

MCA–212. AI and Data Science Laboratory

Full Marks: 100, Weekly Hours: 0 + 0 + 3
Allotted Hrs: 40P
Lab pertaining to MCA-204 and MCA-205

MCA–213. Scientific Computing Laboratory

Full Marks: 100, Weekly Hours: 0 + 0 + 3
Allotted Hrs: 40P
Lab pertaining to MCA-203

MCA–214. Advanced Programming Laboratory-I

Full Marks: 100, Weekly Hours: 0 + 0 + 3
Allotted Hrs: 40P

MCA Part II 1st Semester

MCA–301. Microprocessors and Its Applications

Full Marks: 100, Weekly Hours: 3 + 1 + 0

Allotted Hrs: 40L

Introduction to microprocessors. Microprocessor architecture organization and programming of microprocessor inter-8085.

Data transfer techniques and their implementation: programmed data transfer, DMA transfer, interrupt driven data transfer, serial and parallel communication.

Some common peripherals & their interfacing: key board & display, programmable parallel interface, programmable timer, ADC & DAC etc. development aids and troubleshooting techniques: self-test concepts, memory testing techniques, single stepping technique etc. basic features of some advanced microprocessors: single chip microcomputer, 16-bit & 32-bit microprocessors, RISC & CISC concepts, idea of transputer.

Text Books:

1. Krishna Kant, "MICROPROCESSORS AND MICROCONTROLLERS Architecture,programming and system design using 8085, 8086, 8051 and 8096". PHI 2007.
2. Douglas V Hall, "MICROPROCESSORS AND INTERFACING, PROGRAMMING AND HARDWARE" TMH, 2006.

Reference Books:

1. Muhammad Ali Mazidi, Janice GillispieMazidi, RolinD.MCKinlay The 8051 Microcontroller and Embedded Systems, Second Edition, Pearson Education 2008.
2. Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing The PC", Delmar Publishers, 2007.
3. A K Ray, K M Bhurchandi, Advanced Microprocessors and Peripherals, TMH, 2007.

MCA–302. Computer Networks

Full Marks: 100, Weekly Hours: 3 + 1 + 0

Allotted Hrs: 40L

Communications: Concepts of data transmission, signal encoding, modulation methods, synchronization, multiplexing and concentration, coding method, cryptography.

Networks: Communication system architecture OSI reference model, topology types, selections, design, local area networks(LAN), CSMA/CD, token bus token ring techniques, link level control(LLC) protocols, HDLC, analysis of protocols and performance, concepts in network layer, switching techniques, routing methods.

TCP/IP, Session, Presentation and Application Layers function. Data communication fundamentals-signals and communication channels. Baseband communication, modulation and MODEMS. Channel sharing techniques -FDM, TDM, polling and concentration. Error Detection -CRC codes, framing techniques. Stop-and-wait (PAR) protocol with efficiency analysis.

Network structure and architecture-communication subnet and local access. Circuit, message and packet switching. Elementary queuing theory (results only) with network applications. OSI reference model. Local area networks-Ethernet and token ring LANS. Network layer services and functions. Routing techniques. Network access protocols-X.25 and IP.

Important functions of transport, session and presentation layers-TCP and ISO protocols. Network application-file transfer and file servers, electron mail, virtual terminals, and distributed systems.

Text Book:

1. Behrouz A Forouzan, DeAnzaCollegeFirouzMosharraf: Computer Networks: A Top-Down Approach,

McGraw Hill Education (India) Private Limited (11 November 2011)
2. Comer D E., Internetworking With TCP/IP Principles, Protocols, And Architecture, PHI (2013)

References Books:

1. Tanenbaum A.S., David J. Wetherall : Computer Network, Pearson; Pearson; 5 edition
2. Stalling W.: Data and Computer Communication, Pearson; Nineth edition (2013)
3. Peterson L L, Davie B S, Computer Networks: A Systems Approach, Morgan Kaufmann Publishers In; 5th Revised edition edition
4. Stevens, UNIX Network Programming, Pearson Education; 1ST edition (2003)

MCA–303. Software Engineering
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Software Engineering – Objectives, Definitions, Software Process models - Waterfall Model, Prototyping, RAD, Evolutionary Models, Incremental, Spiral. Software Project Planning- Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model.

Structured Analysis, Context diagram and DFD, Physical and Logical DFDs, Data Modelling, ER diagrams, Software Requirements Specification

Design Aspects: Top-Down and Bottom-Up design; Decision tree, decision table and structured English, Structure chart, Transform analysis Functional vs. Object- Oriented approach.

UML: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram.

Coding & Documentation – Structured Programming, Modular Programming, Module Relationship-Coupling, Cohesion, OO Programming, Information Hiding, Reuse, System Documentation.

Testing – Levels of Testing, Integration Testing, System Testing.

Software Quality, Quality Assurance, Software Maintenance, Software Configuration Management, Software Architecture.

Text Books:

1. Pressman, R.S., Software Engineering: A Practitioner's Approach, McGraw Hill.
2. Rajib Mall: Fundamentals of Software Engineering, Prentice Hall India Learning Private Limited; Fourth edition (2 April 2014)

Reference Books:

1. Ian Sommerville: Software Engineering, Pearson Education; Nineth edition (2013)
2. Fairley, R.E., Software Engineering Concepts, McGraw Hill Education (India) Private Limited (23 April 2001)

MCA–304. Elective - I
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

MCA–305. Elective - II
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

MCA–306. Elective - III

Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

MCA–311. Microprocessor Laboratory
Full Marks: 100, Weekly Hours: 0 + 0 + 3
Allotted Hrs: 40P
Lab pertaining to MCA-301

MCA–312. Web-based Programming Laboratory
Full Marks: 100, Weekly Hours: 0 + 0 + 3
Allotted Hrs: 40P

MCA–313. Advanced Programming Laboratory - II
Full Marks: 100, Weekly Hours: 0 + 0 + 3
Allotted Hrs: 40P

Electives

Elective/1. Computer Graphics
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Display Devices : Line and point plotting systems; raster, vector, pixel and plotters, Continual refresh and storage displays, Digital frame buffer, Plasma panel displays, Very high resolution devices, High-speed drawing, Display processors, Character generators, Colour-display techniques (Shadow-mask and penetration CRT, colour look-up tables. analog false colours, hard-copy colour printers.)
Display Description: Screen co-ordinates, user co-ordinates; Graphical data structures (compressed incremental list, vector list, use of homogeneous co-ordinates); Display code generation; Graphical functions; the view algorithms, two-dimensional transformation.
Interactive Graphics: Pointing and positioning devices (cursor, light pen, digitizing tablet, the mouse, track balls). Interactive graphical techniques; Positioning, Elastic Lines, Inking, Zooming, Panning, Clipping, Windowing, Scissoring.
Graphic Languages: Primitives (constants, actions, operators, variables), plotting and geometric transformations, display subroutines.
3-D Graphics: Wire-frame perspective display, Perspective depth, Projective transformations, Hidden line and surface elimination, transparent solids, Shading. GKS is to be used as the standard teaching tool.

Text Book:
1. Hearn D., Baker P.M. : Computer Graphics, Prentice-Hall, 1986.
2. James D. Foley, Andries van Dam, Steven K. Feiner and John HughesComputer Graphics: Principles and Practice, Addison-Wesley Professional; 3rd edition.

Reference Books:
1. Akenine-Moller, Tomas, Eric Haines and Naty Hoffman. Real-Time Rendering. 3rd ed. A K Peters/CRC Press, 2008

Elective/2. Pattern Recognitions
Full Marks: 100, Weekly Hours: 3 + 1 + 0

Allotted Hrs: 40L

Introduction - Definitions, data sets for Pattern Recognition
Different Paradigms of Pattern Recognition
Representations of Patterns and Classes
Metric and non-metric proximity measures
Feature extraction, Different approaches to Feature Selection
Nearest Neighbor Classifier and variants
Efficient algorithms for nearest neighbour classification
Different Approaches to Prototype Selection
Bayes Classifier, Decision Trees, Linear Discriminant Function
Different Approaches to Prototype Selection, Bayes Classifier
Decision Trees, Linear Discriminant Function
Support Vector Machines, Clustering, Clustering Large datasets, Combination of Classifiers, Applications - Document Recognition.

Text Books:

1. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.

Reference Books:

1. Pattern Recognition Paperback by Narasimha Murthy and Susheela Devi
2. Pattern Recognition and Machine Learning (Information Science and Statistics) by Christopher Bishop

Elective/3. Soft Computing
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction: Introduction to soft computing; introduction to biological and artificial neural network; introduction to fuzzy sets and fuzzy logic systems.
Introduction to Genetic Algorithm, Genetic Operators and Parameters, Genetic Algorithms in Problem Solving, Theoretical Foundations of Genetic Algorithms, Implementation Issues.
Artificial neural networks and applications: Different artificial neural network models; learning in artificial neural networks; neural network applications in control systems. Neural Nets and applications of Neural Network.
Fuzzy systems and applications: fuzzy sets; fuzzy reasoning; fuzzy inference systems; fuzzy control; fuzzy clustering; applications of fuzzy systems.
Neuro-fuzzy systems: neuro-fuzzy modeling; neuro-fuzzy control.
Applications: Pattern Recognitions, Image Processing, Biological Sequence Alignment and Drug Design, Robotics and Sensors, Information Retrieval Systems, Share Market Analysis, Natural Language Processing.

Text Books:

1. M. Mitchell: An Introduction to Genetic Algorithms, Prentice-Hall.
2. J.S.R.Jang, C.T.Sun and E.Mizutani: Neuro-Fuzzy and Soft Computing, PHI, Pearson Education.
3. Timothy J.Ross: Fuzzy Logic with Engineering Applications, McGraw-Hill.
4. Davis E.Goldberg: Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley.

Reference Books:

1. S. Rajasekaran and G.A.V.Pai: Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI.
2. D. E. Goldberg: Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley.

Elective/4. Advanced DBMS
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Distributed DBMS features and needs. Reference architecture. Levels of distribution transparency, replication. Distributed database design –fragmentation, allocation criteria. Storage mechanisms. Translation of global queries. / Global query optimization. Query execution and access plan. Concurrency control – 2 phases locks. Distributed deadlocks. Time based and quorum based protocols. Comparison. Reliability- non-blocking commitment protocols. Partitioned networks. Checkpoints and cold starts.
Management of distributed transactions- 2 phase unit protocols. Architectural aspects. Node and link failure recoveries. Distributed data dictionary management. Distributed database administration. Heterogeneous databases-federated database, reference architecture, loosely and tightly coupled. Alternative architecture. Development tasks, Operation- global task management. Client server databases -SQL server, open database connectivity. Constructing an application.

Text Books:

1. Database System Concepts, SilberschatzKorth, Sudarshan, MH
2. Database Management Systems,Ramakrishnan, MH
3. Beginning SQL Server 2000 programming, Dewson,SPD/WROX

Reference Books:

1. Database Management Systems, Leon, VIKAS
2. My SQL: Enterprise Solutions, AlexenderPachev, Wiley Dreamtech

Elective/5. Embedded System Design
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction: Characteristics of embedded systems; Applications; Concept of real time systems; Challenges in embedded system design.
Embedded Processors: Review of structure of a basic computer system: CPU, memory, I/O devices on a bus; Memory System Mechanisms – Caches, Memory Management Units and Address Translation; I/O subsystem – input and output devices, busy-wait I/O, interrupt driven I/O; Interrupts – Basics, interrupt latency; Co-processors; Processor Performance Enhancement-Pipelining, Superscalar execution, caching.
The Embedded Computing Platform: Board Buses – Bus Arbitration and Timing; The CPU Bus; Memory Devices and their Characteristics – Random-Access memories, Read-Only memories; I/O devices – Timers and Counters, Watchdog timers, GPIO, A/D, D/A, Displays, Keyboards; Component Interfacing – Memory interfacing, device interfacing, interfacing protocols; Designing with processors – System architecture, Hardware design; Target Devices-FPGA, CPLD.
Embedded Software Architectures: Round-Robin; Round-Robin with Interrupts; FunctionQueue-Scheduling Architectures; Real-Time Operating System Architecture; Selecting an Architecture.
Real-time operating systems: Tasks and Task States; Tasks and Data; Context Switching-Cooperative multitasking, Preemptive multitasking; Scheduling Policies-Rate-Monotonic scheduling, Earliest-Deadline-First scheduling, RMS versus EDF; Semaphores and Shared Data; Message Queues; Timer Functions; Events; Memory Management; Priority Inversion; Interrupt Routines in an RTOS Environment.
Low-power computing: Sources of energy consumption: toggling, leakage – Instruction-level nstrategies for power-management: functional unit management - Memory system power consumption: caches, off-chip memory - Power consumption with multiple processes – Systemlevel power management:

deterministic, probabilistic methods.
Hardware Accelerators: CPUs and Accelerators – Why Accelerators, Accelerator Design; Accelerated System Design – Performance Analysis, System Architecture Framework, Partitioning, Scheduling and Allocation, System Integration and Debugging. Networked embedded systems: Why networked embedded systems - Example networked embedded systems: automobiles, factory automation systems - Types of network fabrics - Network performance analysis - Internet-enabled embedded systems.
Design and Development of Embedded Systems: Creating an Embedded System Architecture; Implementing the Design - Embedded Software Development Tools, Host and Target Machines, Linker/Loader for Embedded Software, Getting Embedded Software into Target System, Debugging Techniques and Tools, Testing on the host machine, instruction set simulators, oscilloscopes, logic analyzers, in-circuit emulators, monitors, System Boot-Up; Quality
Assurance and Testing of the Design.

Text Books:
1.Frank Vahid, Tony Givargis: Embedded System Design: A Unified Hardware/Software Introduction, Wiley; Student edition (21 July 2006)
2. Mazidi M. Ali , Mazidi J. G., and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems; Pearson; Second edition (2008)

Reference Books :
1. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufmann; 2 edition (June 16, 2008)
2. David E. Simon, Embedded Software Primer,, Addison-Wesley Professional; 1 edition (August 15, 1999)
3. Raj Kamal: Embedded Systems ; McGraw-Hill Education (India); 2nd Edition (March 9, 2009)

Elective/6. Simulation & Modeling
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Elective/7. Mobile Computing
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction, enabling concepts for mobile and personal communications. Terminal mobility, personal mobility and service mobility. The Intelligent Networks (IN) concept: Mobile and personal communication: Past, Present & Future some related network aspects.
Mobile computing Architecture: History of computers, History of internet, Internet – The ubiquitous Network Architecture for mobile computing, Three tier Architecture, Design considerations for mobile computing, Mobile computing through Internet, Making existing applications mobile enabled.
The cellular concept and its initial implementations: The cellular concept, Multiple access technologies for cellular systems, Cellular system operation and planning (General principles, System Architecture, Location updating and call setup), Handoff and power control. Initial implementations of the cellular concept: The AMPS system, TACS system, NMT system, NTT system, concluding remarks.
Digital cellular mobile systems: Introduction, GSM : The European TDMA digital cellular standard, GSM standardization and service aspects GSM reference architecture and function partitioning, GSM radio aspects, Security aspects, GSM protocol model, Typical call
flow sequences in GSM, Evolutionary directions for GSM IS-136 : The North American TDMA digital cellular standard(D-AMPS), Background on North American digital cellular, Service aspects of D-AMPS(IS-136), Network reference, Radio aspects, Security aspects, Protocol model and typical flow

sequences, Evolutionary directions

Text Book:

1. Mobile Communications by Jochen Schiller, 2nd Edition, Pearson Education Limited
2. Mobile and Personal Communication systems and services, Raj Pandya, Prentice Hall of India, 2001.

Reference Books: 1

1. T. S. Rappaport: Wireless Communications: Principles and Practice, 2nd Edition, PHI
2. Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic: Mobile Ad Hoc Networking: The Cutting Edge Directions, Wiley-IEEE Press; 2 edition (March 4, 2013)

Elective/8. Parallel Processing
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction to Parallel Processing, Parallelism in sequential Mechanics, Abstract
Model, Multiprocessor architecture, Architecture classifications and Techniques. Pipelining, Arithmetic and Instruction Pipelines, Pipelining Hazard. Interconnection Networks, Hyper cubes, Shuffle Exchanges, Trees, Meshes and
Butterfly networks, parallel Algorithm for, linear Algebra, Matrix Multiplication,
Solving linear systems, probabilistic algorithm, and possibility of super linear speedup, Sorting, Vector and Array Processors. Shared Memory Programming, general model of shared Memory Programming, Thread management, attributed, Thread implementation Java Threads. Parallel Processing – Operating Systems for parallel Processors, types, tools and languages Parallel Programming Languages – FORTRAN 90 (Introduction)
Characterization of Distributed Systems – Introduction, Examples of Distributed Systems, Resource sharing and the Web, Challenges. Message passing Model, programming model, PVM, Remote procedure Call – parameter passing, Java Remote Method Invocation Other parallelism paradigms – Data Flow Computing, Systolic Architecture.

Text Books:

1. Scientific Computing, An introduction with parallel computing: Gene Golub/James M.Ortega
2. Introduction to parallel processing: M Sasi kumar, Dinesh S., P. Ravi Prakesh: PHI, 2002.

Reference Books:

1. Parallel Computing, Quinn,TMH
2. Introduction to Parallel Processing, Sashi Kumar,PHI
3. Parallel Programming, Wilkinson, Pearson
4. Elements of Parallel Computing, Rajaraman,PHI
5. Fundamentals of Parallel Processing, Jordan, PHI
6. Advanced Computer Architecture, Hwang, TMH

Elective/9. IoT and Sensor Networks
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction to Sensor networks in smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security, IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints, hardware, Data representation and visualization, Interaction and remote control.

Exemplary Device Board, Linux on Raspberry, Interface and Programming & IoT Device. Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases
Industrial Automation-Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation
Applications: Smart Grid &IoT, Healthcare, Industry automation, Commercial building automation using IoT, Smart cities, recent trends in sensor network and IoT architecture.

Books:
1. Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publication

2. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things by Pearson Paperback – 16 Aug 2017 ,by Hanes David (Author), Salgueiro Gonzalo (Author), Grossetete Patrick (Author), Barton Rob (Author

Elective/10. Digital Image Processing
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction: Digital Image representation; Fundamental steps in Image processing, Elements of digital Image processing systems.
Digital Image Fundamentals: Sampling and quantization, imaging geometry.
Image Transforms: Fourier, Walsh, Hademord, discrete cosine and Hotelling transforms and their properties.
Image Enhancement: Enhancement by point processing, spatial filtering, Frequency domain enhancement, Color image processing.
Image Restoration: Unconstrained and constraint restoring, inverse filtering, Wiener Filter, Geometric transforms.
Image Compression: Image Compression models, Error-free compression, Lossy compression, Image compression standards.
Image Segmentation: Detection of discontinuities, edge linking, Thresholding.
Representations and Descriptions: Chain codes, shape numbers, moments and Fourier and other descriptors. Recognition & Interpretations.

Text Book:
1. Digital Image Processing, Gonzalves,Pearson
2. Digital Image Processing, Jahne, Springer India
3. Digital Image Processing &Analysis,Chanda&Majumder,PHI
4. Fundamentals of Digital Image Processing, Jain, PHI

References Books:
1. Image Processing, Analysis & Machine Vision, Sonka, VIKAS
2. Getting Started with GIS- Clarke Keith. C; PE.
3. Concepts & Techniques of GIS - Lo C.P, Albert, Yeung K.W- PHI.

Elective/11. Managerial Economics
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

The Fundamentals of Managerial Economics: Goals and Constraints The Nature and Importance of Profits Understanding Incentives Economic rationality,Scarcity and opportunity cost Marginal and IncrementalAnalysis Basic Calculus: The Calculus of Optimization.

Theory of Demand:

Demand and Supply Market Equilibrium Price Ceilings and Price Floors Comparative Statics: Changes in Demand and Supply. Price Elasticity of Demand Price Elasticity, Total Revenue, and Marginal Revenue Factors Affecting Price Elasticity Cross Price Elasticity. Income Elasticity of Demand Other Elasticities, Elasticities for Nonlinear Demand Functions. Elasticity of Supply Demand Forecasting Choice and Utility Theory Law of Diminishing marginal utility Consumer Equilibrium Indifference curve Analysis Consumer Surplus Price effect, Substitution Effect and Income Effect.

Theory of Production and Cost:

The Production Function Profit-Maximizing Input Usage. Isoquants and Isocosts Cost Minimization and Optimal Input Substitution. The Cost Function Breakeven analysis, Contribution analysis Long-run Costs and Economies of Scale Multiple Cost Functions and Economies of Scope. Learning curve.

Theory of Market and pricing:

The Nature of Industry Perfect Competition Monopoly Monopolistic Competition Oligopoly Game theory Product pricing.

Text Books:

1. YogeshMaheswari, Managerial Economics, Phi Learning, Newdelhi, 2005 Gupta G.S.
2. Managerial Economics, Tata Mcgraw-Hill, New Delhi Moyer &Harris.

Reference Books:

1. Anagerial Economics, Cengage Learning, Newdelhi, 2005 Geetika, Ghosh & Choudhury, ,
2. Managerial Economics, Tata Mcgrawhill, Newdelhi, 2011

Elective/12. Computational Geometry
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Preliminaries: Basic Euclidean geometry

Grids and Hulls: Fixed-radius near neighbors, convex hull algorithms, dominance and applications.

Linear Programming: Half-plane intersection and randomized LP, backwards analysis, applications of low-dimensional LP.

Intersections and Triangulation: Plane-sweep line segment intersection, triangulation of monotone subdivisions, plane-sweep triangulation of simple polygons.

Point Location: Kirkpatrick's method, trapezoidal decompositions and analysis, history DAGs.

Voronoi Diagrams: Basic definitions and properties, Fortune's algorithm.

Geometric Data Structures: kd-trees, range trees and range searching, segment trees.

Delaunay Triangulations: Point set triangulations, basic definition and properties, randomize incremental algorithm and analysis.

Arrangements and Duality: Point/line duality, incremental construction of arrangements and the zone-theorem, applications.

Geometric Approximation: Dudley's theorem and applications, well-separated pair decompositions and geometric spanners, VC dimension, epsilon-nets and epsilon-approximations,

Geometric Retrieval: kd-trees, range trees, hereditary segment trees, nearest neighbor searching.

Text Books:

1. M. de Berg, M. Van Kreveld, M. Overmars, and O. Schwarzkopf, Computational Geometry:

Algorithms and Applications (3rd Edition), Springer, 2008.
2. F. Preparata and M. Shamos, Computational Geometry, Springer-Verlag, 1985.
3. K. Mulmuley, Computational Geometry: An Introduction Trough Randomized Algorithms, Prentice-Hall, 1994.
4. J. O'Rourke, Computational Geometry in C, 2nd ed., Cambridge Univ. Press, 1998.

Reference Books:
1. K. Mulmuley, Computational Geometry: An Introduction Through Randomized Algorithms, Prentice Hall, 1994.
2. T. Cormen, et.al., Introduction to Algorithms, 2nd ed., MIT Press, 2001.
3. J. O'Rourke, Art Gallery Theorems and Algorithms, Oxford Univ. Press, 1987.
4. R. Motwani and P. Raghavan, Randomized Algorithms, Cambridge Univ. Press, 1995.

Elective/13. Data Mining
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Data Warehousing: Concept of Data Warehouse, Differences between Operational Databases and Date Warehouse, Multi-dimensional Data Model, Schemas for Multi-dimensional Databases, Data Cube Representations, Data Warehouse Architecture, OLTP vs OLAP, Efficient Query processing in data Warehouses, Indexing of OLAP data, Meterialization concept;
Data Mining Data Clustering: Partitioning, Hierarchical, Density-based, Grod Based and Model Based Methods; Classification & Prediction: Decision Tree Techniques, Back-Propagation Method, Bayesian Method Association Rule Mining Techniques: Frequent Itemset Generation, Apriori, Horizontal Method/. Sampling Approach, Hashing Approach; Dynamic Association Rule Mining;
Mining of Complex Types of Data: Mining of Spatial Databases, Multimedia Databases, Timeseries and sequence Data, Text Databases, WWW Data;

Text Book:
1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson; 1 edition (May 12, 2005)

Books/References:
1. Jiawei Han and MichelineKamber: Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers In; 3rd Revised edition edition (25 July 2011)

Elective/14. Distributed Computing
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Fundamentals: Evolution of Distributed Computing Systems, System models, issues in design of Distributed Systems, Distributed computing environment, web based distributed model, computer networks related to distributed systems and web based protocols.
Message Passing: Inter process Communication, Desirable Features of Good Message-Passing Systems, Issues in IPC by Message, Synchronization, Buffering, Multidatagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling, Group Communication.
Remote Procedure Calls: The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management, Communication Protocols for RPCs, Complicated RPCs, Client-Server Binding, Exception Handling, Security, Some Special Types of RPCs, Lightweight RPC, Optimization for Better Performance.
Distributed Shared Memory: Design and Implementation issues of DSM, Granularity, Structure of Shared

memory Space, Consistency Models, replacement Strategy, Thrashing, Other Approaches to DSM, Advantages of DSM.
Synchronization: Clock Synchronization, Event Ordering, Mutual Exclusion, Election Algorithms.
Resource and Process Management:
Desirable Features of a good global scheduling algorithm, Task assignment approach, Load Balancing approach, Load Sharing Approach, Process Migration, Threads, Processor allocation, Real time distributed Systems.
Distributed File Systems: Desirable Features of a good Distributed File Systems, File Models, File Accessing Models, File-shearing Semantics, Filecaching Schemes, File Replication, Fault Tolerance, Design Principles, Sun's network file system, Andrews file system, comparison of NFS and AFS.
Naming: Desirable Features of a Good Naming System, Fundamental Terminologies and Concepts, Systems-Oriented Names, Name caches, Naming & security, DCE directory services.
Case Studies Mach & Chorus (Keep case studies as tutorial)

Books:
1. Distributed OS by Pradeep K. Sinha (PHI)
2. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair: Distributed SystemsConcepts and Design, Addison Wesley; 5 edition

Reference Books:
1. Tanenbaum S.: Distributed Operating Systems, Pearson Education
2. Tanenbaum S. Maarten V.S.: Distributed Systems Principles and Paradigms, (Pearson Education)

Elective/15. Graph Algorithms
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

PageRank algorithm. DFS, BFS, Tarjan's algorithm for strongly connected components. Representation of graphs.
Maze and river network simulation via invasion percolation case study. Minimum spanning trees, Prim-Dijkstra-Jarnik algorithm, Boruvka's algorithm, Kruskal's algorithm.
DAGs and topological ordering.
Road map path planning case study. Shortest paths, relaxation algorithms, Dijkstra's algorithm, Bellman-Ford algorithm, Johnson's algorithm.
A* algorithm, Euclidean distance based distance estimation, landmark-based distance estimation.
Transportation scheduling case study. Euler tours. Travelling salesman problem.
Exponential-time dynamic programming for the TSP, approximation algorithms and the approximation ratio, MST-doubling heuristic, Christofides' heuristic.
Baseball elimination case study. Maximum flow problem, minimum cut problem, max-flow min-cut theorem, augmenting path (Ford-Fulkerson) algorithm.
Medical school residency assignment case study. Matchings, stable marriage, Gale-Shapley algorithm for stable marriage.
Bipartite graphs, formulating bipartite maximum matching as a flow problem, Hopcroft–Karp algorithm.
Using matchings to find vertex covers and independent sets, partition into a minimum number of rectangles.
Graph coloring, greedy coloring, interval graphs, and perfect graphs.
Chordal graphs and using Lexicographic breadth-first search to find an elimination ordering.
Cliques, Moon-Moser bound on maximal cliques, Bron-Kerbosch algorithm.
Planar graphs; review of planarity-related topics from earlier weeks (graph drawing, road maps, invasion percolation via minimum spanning trees of grid graphs, graph coloring and the four-color theorem).
Duality, duality of Euler tours and bipartiteness, Euler's formula, greedy 6-coloring, Boruvka in linear time. Planarity testing, and Fáry's theorem.

Text Books:
1. Introduction to Graph Theory (Dover Books on Mathematics) 2nd Edition by Richard J. Trudeau.
2. Graphs, Algorithms, and Optimization (Discrete Mathematics and Its Applications) by William Kocay and Donald L. Kreher.

Reference Books:
1. Algorithm Design 1st Edition, by Jon Kleinberg and ÉvaTardos
2. The textbook Algorithms, 4th Edition by Robert Sedgewick and Kevin Wayne

Elective/16. VLSI Desing
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Review of Microelectronics and Introduction to MOS Technologies: MOS, CMOS, BiCMOS Technology. Basic Electrical Properties of MOS, CMOS &BiCMOS Circuits: Ids – Vds relationships, Threshold Voltage VT, Gm, Gds and ωo, Pass Transistor, MOS, CMOS & Bi CMOS Inverters, Zpu/Zpd, MOS Transistor circuit model, Latch-up in CMOS circuits.
Layout Design and Tools: Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools. Logic Gates & Layouts: Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays.
Combinational Logic Networks: Layouts, Simulation, Network delay, Interconnect design, Power optimization, Switch logic networks, Gate and Network testing.
Sequential Systems: Memory cells and Arrays, Clocking disciplines, Design, Power optimization, Design validation and testing.
Floor Planning: Floor planning methods, Global Interconnect, Floor Plan Design, Off-chip connections.

Text Book:
1. Essentials of VLSI Circuits and Systems, K. EshraghianEshraghian. D, A. Pucknell, 2005, PHI.
2. Modern VLSI Design – Wayne Wolf, 3rd Ed., 1997, Pearson Education.

Reference Books:
1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
2. Principals of CMOS VLSI Design – N.H.E Weste, K. Eshraghian, 2nd Ed., Addison Wesley.

Elective/17. Numerical & Statistical Computing
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Prerequisite: A Good Knowledge of Linear Algebra and Calculus.
Floating – Point Representation of Number with Finite Precision and Its Consequences. Concepts of Truncation and Round-Off Errors. Roots of Equation: Iterative Methods, Bisection Methods, False Position Method, Newton-Raphson Method, Solution of Polynomial Equation, Solution of Simultaneous Linear Equation. Gaussian Elimination, Pivoting, Ill Conditioning, Gauss-Siedel Iterative Methods, Comparison of Direct and Iterative Methods. Interpolation: Finite Differences, Polynomial Interpolation, Spline Interpolation. Differentiation & Integration: Differentiation by Polynomial Fit, Trapezoidal and Simpson Rules, Gaussian Quadrature. Numerical Solution Of Ordinary Differential Equations: Solution by Taylor Series, Euler's Method, Predictor Corrector Method, Rungi-Kutta Method. Statistical Methods: Sampling, Frequency Distribution. Measures of Central Tendency and Dispersion, Moments, Discrete.

Distribution Binomial and Poisson Distribution, Regression Analysis/Curve Fitting, Correlation Co-Efficient, Multiple, Partial and Rank Correlations, Tests of Significance- X Test, T-Test and F-Test.

Text Books:
1. R. L. Burden and J. D. Faires: Numerical Analysis, Cengage Learning India; 09 edition 2012

Reference Books:
1. David Kincaid & Ward Cheney : Numerical Analysis, American Mathematical Society; Third edition (2010)
2. J. Stoer and R. Bulirsch : Introduction To Numerical Analysis , Springer (sie) (2009)

Elective/18. Advanced Data Structure
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Complexity of algorithms: worst case, average case, and amortized complexity. Algorithm analysis techniques, Amortized Analysis, Garbage collection, Analysis of Quick sort, Fibonacci Heaps, van Emde Boas Trees, Multithreaded Algorithms, Number Theoretic Algorithms, Strings and String Matching Algorithms, Computational Geometry, Lower Bound Theory – NP Completeness, Approximation Algorithms. Non-linear Data Structure: Trees - Binary Trees, Traversals and Threads, Binary Search Trees, Insertion and Deletion algorithms, Height-balanced and weight-balanced trees, B-trees, B+ -trees, Application of trees; Graphs - Representations, Breadth-first and Depth-first Search.

Text Books:
1. A.V. Aho, J.E. Hopcroft, and J.D. Ullman, Data Structures and Algorithms, Addison Wesley, Reading Massachusetts, USA, 1983.
2. Donald Knuth. The Art of Computer Programming: Fundamental Algorithms, Third Edition. Addison-Wesley, 1997. ISBN 0-201-89683-4
3. Donald Knuth. The Art of Computer Programming Volume 3: Sorting and Searching, Third Edition. Addison-Wesley, 1997. ISBN 0-201-89685-0.

Reference Books:
1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to Algorithms, Third Edition. MIT Press and PHI, 2010.
2. Samet, Hanan, Foundations of multidimensional and metric data structures. Morgan Kaufmann, 2006, ISBN 978-0-12-369446-1.
3. Dinesh Mehta and SartajSahni Handbook of Data Structures and Applications, Chapman and Hall/CRC Press, 2007.
4. M.A. Weiss, Data Structures and Algorithms Analysis in C++, Benjamin/Cummins, Redwood City, California, USA, 1994

Elective/19. Network Programming
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction to networking and Internet protocols via programming and hands-on labs.
TCP/IP protocol architecture; user datagram protocol (UDP); multicasting; transmission control protocol (TCP); standard Internet services, and protocol usage by common Internet applications. Sockets programming; client/server; peer-to-peer; Internet addressing; TCP sockets; UDP sockets; raw sockets. Multithreading and exception handling. Finger, DNS, HTTP, and ping clients and servers. Routers and

architectures, routing protocols.
Router and switch configurations, Internet operating systems. Internetwork setup, network topology, wireless internetworking.
Network protocol analyzers; traffic generation.

Text Books:
1. Stevens, UNIX Network Programming, Pearson Education; 1ST edition (2003)
2. Behrouz A Forouzan, De Anza College Firouz Mosharraf: Computer Networks: A Top-Down Approach, McGraw Hill Education (India) Private Limited (11 November 2011)

Reference Books:
1. Comer D E., Internetworking With TCP/IP Principles, Protocols, And Architecture, PHI (2013)
2. Stalling W.: Data and Computer Communication, Pearson; Nineth edition (2013)

Elective/20. Remote Sensing & GIS Applications
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction: Sun and atmosphere, Remote Sensing a historical perspective.
Electromagnetic Radiations: EM radiators, polarization, attenuation.
Thermal radiations, EM for remote sensing.
Fundamental of Radiometry.
Physical Basics of Signatures: Signature OIR, TIR & Microware Region
Remote Sensor: Classifications of Sensors, Sensor parameters.
Resolution- Spatial & Spectral
Optical, Microwave Sensors
Platform: Principle of Sattelite Motion, Types of orbit, Orbit perturbations.
GPS – Data Products: Dataformats, data product generation output media
Date analysis: Visual analysis, Digital Classifications
Application of Remote Sensing: Agriculture, Forestry, Land Cover Studies
Water Resource, Earth System Science
Geographical Interaction System Application.

Text Books:
1. Peter Burrough, Rachael A. McDonnell, Principles of Geographical Information Systems, OUP Oxford; 3rd edition (2015)
2. Marble D F and Calcins, H. W. , Basic Readings in Geographic Information System. Spad Systems Ltd.

Refrence Books:
1. Burrough, P. A., Principles of GIS for land Resource Assesment, Oxford publications
2. Jeffery Star and John Estates, Geographic Information Systems, an Introductory, Prentice Hall Inc.

Elective/21. Network Security
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services

(Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.
Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC.
Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service.
Email privacy: Pretty Good Privacy (PGP) and S/MIME.
IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.
Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET).
Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3. Intruders, Viruses and related threats.
Firewall Design principles, Trusted Systems. Intrusion Detection Systems.

Text Books:
1. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.
2. Hack Proofing your network by Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn IdoDubrawsky, Steve W.Manzuik and Ryan Permeh, Wiley Dreamtech

Reference Books:
1. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.
2. Network Security - Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI.
3. Cryptography and network Security, Third edition, Stallings, PHI/Pearson
4. Principles of Information Security, Whitman, Cengage Learning.

Elective/22. Real Time Systems
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

REVIEW OF OPERATING SYSTEMS
Basic Principles – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Operating System structures.
DISTRIBUTED OPERATING SYSTEMS
Topology – Network types – Communication – RPC – Client server model – Distributed file system – Design strategies.
REAL TIME MODELS AND LANGUAGES
Event Based – Process Based and Graph based Models – Petrinet Models – Real Time Languages – RTOS Tasks –RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.
REAL TIME KERNEL
Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and study of RTOS VX works and COS – Case studies.
RTOS APPLICATION DOMAINS
RTOS for Image Processing – Embedded RTOS for voice over IP – RTOS for fault Tolerant Applications

– RTOS for Control Systems.

TEXT BOOKS:
1. Tanenbaum, “Distributed Operating Systems”, Pearson Education.
2. Raymond J.A.Bhur, Donald L.Bailey, “An Introduction to Real Time Systems”, PHI 1999.

REFERENCE BOOKS
1. Charles Crowley, “Operating Systems-A Design Oriented approach”, McGraw Hill 1997.
2. C.M. Krishna, Kang, G.Shin, “Real Time Systems”, McGraw Hill, 1997.

Elective/23. Multicriteria Decision Making
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Elective/24. Computer Communication Principles
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Amplitude and Frequency Modulation – their generation and detection Bandwidth requirements Low Power and High
Modulators and Modulated amplifiers. Superheterodyne detection. Signal to Noise ratio of A.M. and P.M. transmission.
A/D, D/A Converters. Shannon’s sampling Theorem. PAM, PWM, PPM and PCM. Their generation and detection.
Digital Modulation: ASK, FSK, PSK performance evaluation. Time Division Multiplexing and Demultiplexing.
Modems, Error control and coding, Channel capacity.
Data Transmission Synchronization, Data protection, error detection and correlation.
Elements of Satellite Communication tracking and control.

Text Books:
1. Taub H. and Shilling D. L., “Principles of Communication Systems”, 2/e,TMH
2. Carlson R. B., “Communication Systems, 4/e, Mc.Graw Hill
3. Lathi B. P., “Communication Systems”, John Wiley.

Reference Books:
1. Kennedy—Electronic Communication Systems, 4/e , TMH
2. Haykin S. S., “An Introduction to Analog and Digital Communication Systems”, Wiley Eastern.

Elective/25. Managerial Accounting
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Financial Accounting – An Introduction: Introduction , Meaning of Accountancy, book-keeping and Accounting , Accounting Process, Objectives for accounting , Differences between book-keeping and accounting Users of accounting information , Limitations of Accounting , Basic terminologies

Accounting Concepts, Principles, Bases and Policies: Introduction , Accounting Concepts, Principles, Policies and Standards, Types of accounting concepts - Business Separate entity concept - Going concern

concept - Money measurement concept - Periodicity concept - Accrual concept, Accounting Principles - Principle of Income recognition - Principle of expense - Principle of matching cost and revenue - Principle of Historical costs - Principle of full disclosure - Double aspect principle - Modifying Principle - Principle of materiality - Principle of consistency - Principle of conservatism or prudence, Accounting Policies - Changes in Accounting Policies - Disclosure in case of changes in Accounting Policies, Accounting Standards - Scope and functions of Accounting Standards Board - International Financial Reporting System

Double Entry Accounting: Introduction , Meaning of double entry accounting, Classification of accounts under Traditional approach, Classification of accounts under Accounting Equation approach, Comparison of traditional approach with Modern approach equal approach, Accounting Trail , Transactions and events , Meaning and roles of debit and credit , Accounting equation

Secondary Books: Introduction , Secondary books , Purchases Book/Purchases Day book - Cash discount, Trade discount - Difference between cash discount and trade discount, Sales Book or Sales Day book - Purchase Returns Book - Sales Returns Book, Bills receivable book - Bills payable book - Cash book , Posting to Ledger accounts Posting to Ledger

Trial Balance: Introduction , Meaning , Objectives of preparing a trial balance , Methods of preparing a trial balance, Preparation of Trial balance, Adjusting Entries , Errors and their rectification, Errors disclosed by Trial Balance , Errors not disclosed by Trial Balance , Steps to locate the errors

Final Accounts: Introduction , Adjustments before preparing final accounts , Depreciation , Bad Debts and accounting treatment of bad debts , Provision for doubtful debts , Reserves for Discount on Debtors , Reserve for Discount on Creditors , Closing Stock, Trading Account , Profit and Loss Account, Balance Sheet

Introduction to Management Accounting: Introduction, Meaning of Management accounting ,The Role of Management Accounting , Management Accounting Framework , Functions of Management Accounting ,Tools of Management Accounting ,The Balanced Scorecard , Cost Management System , Value Added Concept , Merits of Management Accounting , Demerits of Management Accounting , Distinction between Management Accounting and Financial Accounting

Financial Statement Analysis: Introduction , Meaning of Ratio , Steps in Ratio Analysis, Classification of Ratios , Du Pont Chart , Solved Problems , Advantages of Ratio Analysis, Limitation of Ratio analysis

Funds Flow Analysis: Introduction, Meaning of Funds Flow Statement, Ascertainment of flow of funds, Technique of preparing funds flow statement, Schedule of Changes in Working Capital, Adjusted Profit and Loss account, Funds Flow Statement
Cash Flow Analysis: Introduction, Meaning of Cash Flow Statement, Purpose of Cash Flow Statement , Preparation of Cash Flow Statement, Format of Cash Flow Statement (AS3: Revised Method) , Cash Flow from Operating Activities , Cash Flow Statement under Direct Method , Different between Cash Flow Analysis and Fund Flow Analysis, Uses of Cash Flow Statement

Understanding Cost: Introduction, Meaning of Cost, Objective of Costing, Methods of Costing, Technique of Costing, Classification of Cost, Elements of Cost, Statement of Cost Sheet, Solved Problems

Marginal Costing and Break Even Analysis: Introduction , Concept of Marginal Costing , Characteristics of Marginal Costing , Difference between Absorption Costing and Marginal Costing , Marginal Cost, Contribution , Cost Volume Profit (CVP) Analysis , Break Even Chart , Break Even Point, Profit Volume ratio or MCSR , Target profit , Margin of Safety , Application of Marginal cost , Limitations of Marginal

cost, Solved Problems

Decisions Involving Alternative Choices: Introduction, Decision Making, Types of Costs, Types of Choices Decisions, Make or Buy Decisions, Addition / Discontinuance of a Product line, Sell or Process Further, Operate or Shut down, Exploring New Markets, Maintaining a desired level of profit

Budgetary Control: Introduction , Meaning of a Budget , Budgetary control , Objectives of budgetary control, Merits of budgetary control, Essential features of Budgetary Control , Steps in budgetary Control , Types of Budgets , Cast Budget , Flexible Budget , Limitation of Budget Control

Standard Costing: Introduction , Definition of Standard Costing, Meaning, Difference between Standard cost and Budgetary Control, Establishment of standards, Variance analysis, Material cost variance, Material price variance, Material usage variance , Material Mix variance, Material Yield variance, Direct labor variance, Labor Efficiency Variance, Labor Rate variance, Labor mix variance, Labor Yield Variance

Text Books:
1. Managerial Accounting, ISV (WSE) Paperback – 2012 by James Jiambalvo
2. Managerial Accounting 5th Edition by John Wild and Ken Shaw

Reference Books:
1. Managerial Accounting, 14th Edition 14th Edition by Ray Garrison (Author), Eric Noreen (Author), Peter Brewer
2. Managerial Accounting, 2nd Edition, RamjiBalakrishnan

Elective/26. Formal Language and Automata Theory
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction: Symbols, Strings, Alphabets and Languages. Set Properties. Kleen's Star. Chomsky Hierarchy.
Regular Language and Finite Automata: Introduction to Finite Automata. DFA definition and construction. NFA definition and construction. DFA vs NFA. Conversion. Introduction to regular language and expression. Closure Properties. Pumping Lemma. Construction of automata from regular expression and vice versa. DFA reduction. Regular grammar.
Context Free Language and Push Down Automata: Definition and construction of PDA. DPDA vs NPDA. Context Free Language and Grammar. Closure properties. Parse trees and Ambiguity. Reduction. Normal Forms.
Context Sensitive Language and Linear Bounded Automata: Introduction and Definition.
Turing Machine: Unbounded Languages. Introduction to Turing Machine. Definition and construction of Turing Machine. Single and Multi-tape TM. Parameter theorem, Diagonalisation, Reducibility, Rice's Theorem and its applications. Church Turing Thesis. Universal Turing Machine. Halting Problem.
Overview of Computational Complexity and Different Complexity Classes**.**

Text Books:
1. Peter Linz. "An Introduction to Formal Languages and Automata". Narosa.
2. Hoperoft, Aho, Ullman, "Introduction to Automata theory, Language & Computation" 3rd Edition.Pearson Education. 2006

Reference Books:

1.Daniel I.A.Cohen, “Introduction to computer theory”. John Wiley,1996
2. Lewis & Papadimitriou, “Elements of the theory of Computation”. PHI 1997.
3. N. J. Cutland: “Computability: An Introduction to Recursive Function Theory”, Cambridge University Press, London, 1980.

Elective/27. Compiler Design
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Compiler Structure & Lexical Analysis Compiler Structure: Compilers and Translators, Analysis-Synthesis Model of Compilation, Various Phases of Compiler, Pass Structure, Bootstrapping & Compiler Construction Tools. Lexical Analysis: Interface with input, parser and
symbol table, token, lexeme and patterns, difficulties in lexical analysis, Error Reporting, Regular definition, Transition diagrams, LEX. Capabilities of Lexical Analyzer
Finite Automata: Nondeterministic Finite Automata, Deterministic Finite Automata, Subset Construction, Thompson’s construction, DFA State Minimization. The Syntactic Specification of Programming Languages: CFG, Derivation and Parse tree, Ambiguity, Capabilities of CFG.
Basic Parsing Techniques: Top-Down parsers with backtracking, Recursive Descent Parsers, Predictive Parsers, No recursive Predictive Parsers, Bottom–up Parsers, Shift-Reduce Parsing, Operator Precedence Parsers, LR parsers. YACC, Syntax Directed Definitions, Type checking.

Text Books:

1. Alfred V Aho , Jeffrey D. Ullman: “Principles of Compiler Design”, Narosa Publ. House.
2. A.V. Aho, R. Sethi and J.D Ullman: “Compiler: principle, Techniques and Tools”, Addison Wesley.

Reference Books:

1. *Compiler Construction: Principles and Practice*, Kenneth C. Louden, PWS Publishing, 1997, ISBN 0-534-93972-4.
2. Tremblay and Sorenson: "The theory and Practice of Compiler Writing" – McGraw Hill.

Elective/28. E-Commerce
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Computer Systems in Electronic Business
Business Process Re-Engineering
Electronic commerce Policy and Theory
Supply Chain Management
Customer Relationship Management
International trading network & communication protocols
Electronic payment standards
E-Commerce strategy, Marketing and Business Processes.

Text Books:

1. E-Commerce & managerial Perspective,Joseph,PHI
2. E Commerce, Rayport, TMH

Reference Books:

1. E Commerce, Diwan& Sharma, EXCEL
2. Creating & winning E-Business, Napier,VIKAS

Elective/29. Values & professional Ethics
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Science, Technology and Engineering as Knowledge and as Social and Professional Activities.
Effects of Technological Growth:
Rapid Technological growth and depletion of resources. Reports of the Club of Rome. Limits to growth; sustainable development. Energy Crisis; Renewable Energy Resources.
Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations. Environmental Ethics. Appropriate Technology Movement of Schumacher: later developments. Technology and developing nations.
Problems of Technology transfer. Technology assessment/ impact analysis; Industrial hazards and safety, safety regulations safety engineering. Politics and technology, authorization versus democratic control of technology; Human Operator in Engineering projects and industries. Problems of man machine interaction. Impact of assembly line and automation. Human centred Technology.
Ethics of Profession:Engineering profession: Ethical issues in engineering practice. Conflicts between business demands and professional ideals. Social and ethical Responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond.
Case studies: Profession and Human Values, Value Crisis in contemporary society. Nature of values: Value Spectrum of a 'good' life Psychological values: Integrated personality; mental health. Societal values: The modern search for a 'good' society, justice, democracy, secularism, rule of law; values in Indian Constitution. Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity Moral and ethical values: Nature of moral judgments; canons of ethics; Ethics of virtue; ethics of duty; ethics of responsibility. Work ethics, professional ethics.

Text Books:
1. Blending the best of the East & West, Dr. Subir Chowdhury, EXCEL
2. Ethics& Mgmt. & Indian Ethos, Ghosh, VIKAS
3. BusinessEthics,Pherwani,EPH

Reference Books:
1. Ethics,Indian Ethos & Mgmt., Balachandran,Raja,Nair, Shroff Publishers
2. Business Ethics: concept and cases, Velasquez, Pearson

Elective/30. Cloud Computing
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction to cloud computing – Overview of Computing, Cloud Computing NIST Model, Properties, characteristics and disadvantages, role of open standards.
Cloud computing architecture – cloud computing stack, service Models (XaaS), IaaS, Paas, SaaS, Daas, Deployment Models, private, public, hybrid, commercial cloud models.
Service management in Cloud computing – service level agreement (SLA), SLA violation, cloud economics.
Resource management in cloud computing – resource sharing, scalability, elasticity, transparency.
Data management in cloud computing – looking at data scalability and cloud services, database and data stores in cloud, large scale data processing

Cloud security – infrastructure security, data security and storage, identity and access management, access control, trust, reputation risk
Cloud simulators – CloudSim, CloudAnalyst, MultiRecCloudSim, CloudSimPlus, GreenCloudSimulator
Research trend in Cloud compting, green cloud computing, fog computing

Text Books:
1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013
2. Mastering Cloud Computing by RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, McGraw Hill
3. Education (India) Private Limited, 2013

Reference Books:
1. Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill
2. Cloud Computing, Miller, Pearson
3. Building applications in cloud:Concept, Patterns and Projects, Moyer, Pearson

Elective/31. Computational Biology
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction to molecular biology, cell, chromosome, DNA, RNA, proteins, Central Dogma, protein structures, computational biology and bioinformatics tasks;
Sequence databases,sequence comparison, sequence alignment, local and global sequence alignment, multiple sequence alignment, web tools for sequence comparisons;
Sequencing, genome sequencing, fragment assembly, next-generation sequencing, handling errors in sequencing, gene finding, promoter identification, sequence-based protein classification;
Protein structures, structure prediction from sequence, motif finding, structure alignment, structure-based protein classification, molecular design and docking;
Phylogeny analysis, phylogenetic tree construction algorithms, parsimony and distance-based techniques;
Gene expression analysis, microarray, microarray analysis, differential expression, microarray clustering,biclustering, classification, gene marker prediction, gene selection, gene ordering, gene prioritization, gene significance analysis, gene co-expression, differential co-expression;
Biological networks, protein-protein interactions, gene regulatory networks, metabolic networks, network analysis and prediction, systems biology;
Biological databases, sequence databases, gene/protein databases, protein structure/domain databases, microarray gene expression databases, protein-protein interaction databases, gene regulatory network databases, metabolic network databases.

Text Books:
1. Carlos Setubal and Joao Meidanis, “Introduction to Computational Molecular Biology”, Brooks/Cole.

Reference Books:
1. Molecular Cell Biology by DaidBaltimar
2. Aurther M. Lesk, Introduction to Bioinformatics, Oxford University Press, 4th edition (2014)
3. Dan E. Krane and Michael L. Raymer, Fundamental Concepts of Bioinformatics Krane and Raymer, DORLING KINDERSLEY (RS); First edition (2003)
4. David Mount : Bioinformatics: Sequence and Genome Analysis, CBS; 2 edition (2005)

Elective/32. Big Data Analytics
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction, Dawn of the Big Data Era, Definition and Features of Big Data, Big Data Value, The Development of Big Data, Challenges of Big Data, Big Data and its importance, Drivers, Big data analytics, Storage System for Massive Data, Distributed Storage System, Storage Mechanism for Big Data - Database Technology, Design Factors, Database Programming Model
Traditional Data Analysis, Big Data Analytic Methods, Architecture for Big Data Analysis - Real-Time vs. Offline Analysis, Analysis at Different Levels, Analysis with Different Complexity, Tools for Big Data Mining and Analysis.
Data Storage and Analysis, Comparison with Other Systems, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop(MapReduce, Java MapReduce), Scaling Out, Hadoop Streaming, Hadoop Pipes, Task trackers, Hadoop Configuration, NoSQL Data Management, Hadoop with R and Python, Introduction to Apache Spark, Hadoop vs Spark, Map-reduce using Spark, Big Data tools and techniques, Pig and Hive.
Applications of big data analytics in healthcare, transportation, finance and banking, IoT and sensor networks, social networks, NLP, smart cities etc.

Books:

1. Boris lublinsky, Kevin T. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk Deroos et al. “Understanding Big data”, McGraw Hill, 2012.
3. Tom White, “HADOOP: The definitive Guide”, O Reilly 2012.
4. Karau, Holden, et al. *Learning spark: lightning-fast big data analysis*. " O'Reilly Media, Inc.", 2015.
5. Prajapati, Vignesh. *Big data analytics with R and Hadoop*. Packt Publishing Ltd, 2013.

Elective/33. Blockchain Technology
Full Marks: 100, Weekly Hours: 3 + 1 + 0
Allotted Hrs: 40L

Introduction of Cryptography and Blockchain: What is Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions And Blocks, P2P Systems, Keys As Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.
BitCoin and Cryptocurrency: What is Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain And Digital Currency, Transactional Blocks, Impact Of Blockchain Technology On Cryptocurrency.
Introduction to Ethereum: What is Ethereum, Introduction to Ethereum, Consensus Mechanisms, How Smart Contracts Work, Metamask Setup, Ethereum Accounts, Receiving Ether’s What's a Transaction?, Smart Contracts.
Introduction to Hyperledger: What is Hyperledger? Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer.
Solidity Programming:
Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types (Int, Real, String, Bytes, Arrays, Mapping, Enum, address)
Blockchain Applications: Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

Reference Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19,

2016).
2. Antonopoulos, Mastering Bitcoin.
3. Antonopoulos and G. Wood, Mastering Ethereum.
4. D. Drescher, Blockchain Basics. Apress, 2017.

Elective: Machine Learning

Full Marks: 100, Weekly

Hours: 3 + 1 + 0Allotted

Hrs: 40L

Advanced clustering methods, variants of K-means, BIRCH, DBSCAN, Expectation-Maximization,Cluster Evaluation Techniques – Internal and External, clustering ensemble. Linear Discriminant Analysis, Support Vector Machine, Naïve Bayes, Gradient Descent, Class Evaluation Measures, Overfitting, Bias Variance Trade-off Precision, Recall, F1 Score, ROC, AUC,Validation Strategies.
Neural Network, LTU, Perceptron, MLP, Activation Function, Loss Functions, Optimizers, MomentumAdadelta, RMSProp, Adam, Early Stopping, drop-out, Batch Normalization; Word Embedding, CboW,Skip-gram, Glove, ElMo, CNN, RNN, LSTM, GRU, Encoder-Decoder Network, Transfer, Auto Encoder, Generative Adversarial Network; Ensemble Methods - Bagging, Committee Machines and Stacking, Ensemble Methods – Boosting, Gradient Boosting; Undirected Graphical Models, Markov Chains, Random walk Monte Carlo, HMM, Variable elimination, belief propagation, Introduction to Reinforcement Learning, Sampling-based techniques, Q Learning, Introduction to XAI, Lime, SHAP etc. Learning from online streaming data, Machine Learning Applications.

Books:

1. Machine Learning, Tom Mitchell, McGraw Hill, 1997.
2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Second Edition.Feb 2009. Trevor Hastie, Robert Tibshirani, Jerome Friedman.
3. Introduction to Machine Learning, third edition. Ethem Alpaydin. The MIT Press. September2014: ISBN: 978-0-262-028189

Academic Calendar(Proposed) 2021-2022

MCA 1st year 1St Semester	
Commencement of classes	15th September, 2021
1st Assessment	Commences from 9th November, 2021
2nd Internal Assessment	Commences from 15th January,2022
Dissolution of Classes	31st January, 2022
End term Examination to be completed by	16th February, 2022
Publication of Results	28th February, 2022
MCA 1st year 2nd Semester	
Commencement of classes	2nd March, 2022
1st Internal Assessment	Commences from 26th April, 2022
2nd Internal Assessment	Commences from 30th May, 2022
Dissolution of Classes	17th June, 2022
End term Examination to be completed by	12th July, 2022
Publication of Results	30th July, 2022
MCA 2nd year 1st Semester	
Commencement of classes	25th July, 2021
1st Internal Assessment	Commences from 3rd Oct., 2021
2nd Internal Assessment	Commences from 26th Nov., 2021
Dissolution of Classes	3rd January, 2022
End term Examination to be completed by	25th Jan., 2022
Publication of Results	15th February, 2022
MCA 2nd year 2nd Semester	
Commencement of classes	24th January, 2022
1st Internal Assessment	Commences from 28th March., 2022
2nd Internal Assessment	Commences from 2nd May, 2022
Dissolution of Classes	22nd May, 2022
End term Examination to be completed by	17th June, 2022
Publication of Result	5th July, 2022

M.Tech 1st Year 1St Semester	
Commencement of classes	25th July, 2021
1st Assessment	Commences from 9th October, 2021
2nd Internal Assessment	Commences from 4th December,2021
Dissolution of Classes	24th December, 2021
End term Examination to be completed by	18th January, 2022
Publication of Results	31st January, 2022
M.Tech 1st Year 2nd Semester	
Commencement of classes	24th January, 2022
1st Internal Assessment	Commences from 26th March, 2022
2nd Internal Assessment	Commences from 30th April, 2022
Dissolution of Classes	17th may, 2022
End term Examination to be completed by	17th June, 2022
Publication of Results	15th July, 2022
M.Tech 2nd Year 1St Semester	
Commencement of classes	25th July, 2021
1st Internal Assessment	Commences from 3rd Oct., 2021
2nd Internal Assessment	Commences from 26th Nov., 2021
Dissolution of Classes	3rd January, 2022
End term Examination to be completed by	25th Jan., 2022
Publication of Results	5th February, 2022
M.Tech 2nd Year 2nd Semester	
Commencement of classes	24th January, 2022
1st Internal Assessment	Commences from 28th March., 2022
2nd Internal Assessment	Commences from 2nd May, 2022
Dissolution of Classes	22nd May, 2022
End term Examination to be completed by	17th June, 2022
Publication of Result	5th July, 2022

- Academic Time Table with the name of the Faculty members handling the Course

Department of Computer Science and Engineering
University of Kalyani
Class Schedules for Even Semesters - 2020

	Courses	10.15am – 11.05am	11.05am – 12.00pm	12.00pm – 12.55pm		1.30pm – 2.25pm	2.25pm – 3.20pm	3.20pm – 4.15pm	4.15pm – 5.10pm
Mon	M.Tech Part-I		CSE 201 (JKM)	CSE 201 (JKM)		CSE 201L (JKM/DS/UB)	CSE 201L (JKM/DS/UB)	CSE 201L (JKM/DS/UB)	
	M.C.A. Part-I	MCA 201L (PRS)	MCA 201L (PRS)	MCA 201L (PRS)		MCA 201 (PRS)	MCA 201 (PRS)	MCA 205 (SKB)	MCA 205 (SKB)
	M.C.A. Part-II		MCA 404 (DS)	MCA 404 (DS)		MCA 402L (SM)	MCA 402L (SM)	MCA 402L (SM)	
Tue	M.Tech Part-I	CSE 203 (JP)	CSE 203 (JP)	CSE 204E (KM/JKM)	R	CSE 204E (KM/JKM)	CSE 201L (JKM/DS/UB)	CSE 201L (JKM/DS/UB)	CSE 201L (JKM/DS/UB)
	M.C.A. Part-I	MCA 203 (SM)	MCA 203 (SM)	MCA 203L (UB)	E	MCA 203L (UB)	MCA 203L (UB)		
	M.C.A. Part-II	MCA 403L (AM)	MCA 403L (AM)	MCA 403L (AM)		MCA 405 (AM)	MCA 405 (AM)	MCA 404 (DS)	MCA 404 (DS)
					C				
Wed	M.Tech Part-I		CSE 204E (KM/JKM)	CSE 204E (KM/JKM)		CSE 202 (DS)	CSE 202 (DS)	CSE 203P (JP)	CSE 203P (JP)
	M.C.A. Part-I		MCA 205 (SKB)	MCA 205 (SKB)	E	MCA 204 (UB)	MCA 204 (UB)	MCA 202 (PRS)	MCA 202 (PRS)
	M.C.A. Part-II	MCA 403 (RM)	MCA 403 (RM)	MCA 405 (AM)		MCA 405 (AM)			
					S				
Thu	M.Tech Part-I			CSE 203P (JP)		CSE 202 (DS)	CSE 202 (DS)	CSE 205E (AM)	CSE 205E (AM)
	M.C.A. Part-I		MCA 203 (SM)	MCA 203 (SM)		MCA 204 (UB)	MCA 204 (UB)	MCA 201 (PRS)	MCA 201 (PRS)
	M.C.A. Part-II		MCA 401 (KM)	MCA 401 (KM)	S	MCA 403 (RM)	MCA 403 (RM)	MCA 402 (SM)	MCA 402 (SM)
Fri	M.Tech Part-I		CSE 205E (AM)	CSE 205E (AM)		CSE 201 (JKM)	CSE 201 (JKM)	CSE 203 (JP)	CSE 203 (JP)
	M.C.A. Part-I		MCA 202L (PRS/RM)	MCA 202L (PRS/RM)		MCA 202L (PRS/RM)	MCA 202 (PRS)	MCA 202 (PRS)	
	M.C.A. Part-II	MCA 401L (KM/RK)	MCA 401L (KM/RK)	MCA 401L (KM/RK)		MCA 401 (KM)	MCA 401 (KM)	MCA 402 (SM)	MCA 402 (SM)

Dr. Kalyani Mali
Dept. of Computer Sc. & Engg.
University of Kalyani
Kalyani - 741 235, W.B., India

Subjects	Subjects
CSE 201: Advanced Network Security & TCP/IP Programming (JKM) CSE 202: Mobile and Wireless Computing (DS) CSE 203: Advanced Database System (JP) CSE 204E: Elective-I - Pattern Recognition (CS-IV) (KM) / Real Time Systems (CS-III)(JKM) CSE 205E: Elective-II- Data Warehousing and Data Mining (IT-II) (AM) CSE 201L: Advanced Communication Lab (JKM/DS/UB) CSE 201P: Advanced Network Security & TCP/IP Programming Lab. (JKM) CSE 203P: Advanced Database System Lab (JP) MCA 201: Data Structure (PRS) MCA 202: Numerical and Statistical Computing (PRS) MCA 203: Computer Organization and Architecture (SM) MCA 204: Microprocessor (UB) MCA 205: Mathematical Foundation-II (SKB) MCA 201L: Data Structure Lab (PRS) MCA 202L: Numerical Lab (PRS) MCA 203L: Microprocessor Lab (UB)	MCA 401: Computer Graphics (KM) MCA 402: Java and Web Technology (SM) MCA 403: Computer Networks (RM) MCA 404: Software Engineering (DS) MCA 405: Artificial Intelligence (AM) MCA 401L: Graphics Lab (KM) MCA 402L: Java and Web technology Lab (SM) MCA 403L: Artificial Intelligence Lab (AM) **Faculties** KM: Dr. Kalyani Mali, Department of CSE, KU JKM: Dr. J. K. Mandal, Department of CSE, KU UB: Dr. Utpal Biswas, Department of CSE, KU PRS: Dr. Priya Rangan Sinha Mahapatra, Department of CSE, KU AM: Dr. Anirban Mukhopadhyay, Department of CSE, KU DS: Dr. Debabrata Sarddar, Department of CSE, KU SM: Mr. Sukanta Majumder, Department of CSE, KU SKB. Dr. S. K. Basu, Department of CSE, KU RM: Mr. Riman Mandal, Department of CSE, KU JP: Mr. Jaydeep Paul, Department of CSE, KU RK: Mr. RatneshKumar, Department of CSE, KU

- Teaching Load of each Faculty: As per AICTE norms.

- Internal Continuous Evaluation System and place:Yes, It is available.
- Student's assessment of Faculty, System in place: NA

16. Enrollment of Students in last 3 years:

Course	Session	Enrolled Students
MCA	2020-2021	27
	2019-2020	14
	2018-2019	23
MTech(CSE)	2020-2021	18
	2019-2020	10
	2018-2019	16

17. List of Research Projects/ Consultancy Works:

- Number of Projects carried out, funding agency, Grant received:

Name of the Investigator	*Title of the project and duration*	*Amount sanctioned*	*Funding Agency*
Prof. Anirban Mukhopadhyay	Developing Computational Techniques and Databases for Prediction and Analysis of Host-Pathogen Protein-Protein Interactions Involved in Neglected Tropical Diseases	Rs. 8.61 lakh	Dept. of Science & Technology and Biotechnology, Govt. of West Bengal
Prof. Priya Ranjan Sinha Mahapatra	Algorithmic Studies on Geometric Covering Problems to Find a Placement of Facilities for Smart City Planning	Rs. 6.6 lakh	DST-SERB, Govt. of India
Prof. Anirban Mukhopadhyay	Attributed Temporal Weighted Social Network Models for Prediction and Control of Contagious Disease Epidemics	Rs. 6.6 lakh	DST-SERB, Govt. of India

- Publications (if any) out of research in last three years out of masters projects:
  1. Sujit Das , Jyotsna Kumar Mandal2, Arundhati Bhowal," Bit Plane Based Image Authentication in Spatial Domain", International Journal of Computer Sciences and Engineering, Vol.7, Jan 2019.
- Industry Linkage: NONE
- MoUs with Industries: NONE

18. EOA Reports Till date:

All India Council for Technical Education
(A Statutory body under Ministry of HRD, Govt. of India)

7th Floor, Chandralok Building, Janpath, New Delhi- 110 001
PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 www.aicte-India.org

F.No. Eastern/1-2811606740/2016/EOA Date: 30-Apr-2016

To,

The Secretary (Technical education)
Govt. of West Bengal,
Bikash Bhawan, Room No. 602,
6th Floor Salt Lake, Kolkata-700091

Sub: Extension of approval for the academic year 2016-17

Ref: Application of the Institution for Extension of approval for the academic year 2016-17

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2012 notified by the Council vide notification number F-No.37-3/Legal/2012 dated 27/09/2012 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

Regional Office	Eastern	Application Id	1-2811606740
Name of the Institute	UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING	Permanent Id	1-4703201
Name of the Society/Trust	UNIVERSITY OF KALYANI	Institute Address	UNIVERSITY OF KALYANI DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING , KALYANI, DIST.- NADIA, WEST BENGAL, PIN -741235, KALYANI, NADIA, West Bengal, 741235
Institute Type	Govt aided	Society/Trust Address	UNIVERSITY OF KALYANI, DEPT OF COMPUTER SCIENCE AND ENGINEERING,,KALYANI,NADIA,West Bengal,741235

Opted for change from Women to Co-ed and Vice versa	No	Opted for change of name	No	Opted for change of site	No
Change from Women to Co-ed approved and Vice versa	Not Applicable	Change of name Approved	Not Applicable	Change of site Approved	Not Applicable

To conduct following courses with the intake indicated below for the academic year 2016-17

Application Id: 1-2811606740			Course	Full/Part Time	Affiliating Body	Intake 2015-16	Intake Approved for 2016-17	NRI Approval status	PIO / FN / Gulf quota Approval status	Foreign Collaborarion/Twining Program Approval status
Program	Shift	Level								

All India Council for Technical Education
(A Statutory body under Ministry of HRD, Govt. of India)

7th Floor, Chandralok Building, Janpath, New Delhi- 110 001
PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 www.aicte-India.org

ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	COMPUTER SCIENCE AND ENGINEERING	FULL TIME	Kalyani University, Nadia	18	18	NA	No	N
MCA	1st Shift	POST GRADUATE	MASTERS IN COMPUTER APPLICATIONS	FULL TIME	Kalyani University, Nadia	30	30	NA	No	N

The above mentioned approval is subject to the condition that UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING shall follow and adhere to the Regulations, guidelines and directions issued by AICTE from time to time and the undertaking / affidavit given by the institution along with the application submitted by the institution on portal.

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Strict compliance of Anti-Ragging Regulation:- Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

Note: Validity of the course details may be verified at www.aicte-india.org

Prof. Alok Prakash Mittal
Member Secretary, AICTE

Copy to:

1. **The Regional Officer,**
   All India Council for Technical Education
   College of Leather Technology Campus
   Block LB, Sector III, Salt Lake City
   Kolkata - 700 098, West Bengal

2. **The Director Of Technical Education,**
   West Bengal

3. **The Registrar,**
   Kalyani University, Nadia

4. **The Principal / Director,**
   UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
   UNIVERSITY OF KALYANI
   DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING ,
   KALYANI, DIST.- NADIA,
   WEST BENGAL,
   PIN -741235,
   KALYANI,NADIA,
   West Bengal,741235

5. **The Secretary / Chairman,**
   UNIVERSITY OF KALYANI
   UNIVERSITY OF KALYANI,

DEPT OF COMPUTER SCIENCE AND ENGINEERING,,
KALYANI,NADIA,
West Bengal,741235

6. **Guard File(AICTE)**

All India Council for Technical Education

(A Statutory body under Ministry of HRD, Govt. of India)

Nelson Mandela MargVasant Kunj, New Delhi-110067
PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 www.aicte-India.org

F.No. Eastern/1-3324188111/2017/EOA Date: 30-Mar-2017

To,

The Secretary (Technical education)
Govt. of West Bengal,
Bikash Bhawan, Room No. 602,
6th Floor Salt Lake, Kolkata-700091

Sub: Extension of approval for the academic year 2017-18

Ref: Application of the Institution for Extension of approval for the academic year 2017-18

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2016 notified by the Council vide notification number F.No.AB/AICTE/REG/2016 dated 30/11/2016 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

Permanent Id	1-4703201	Application Id	1-3324188111
Name of the Institute	UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING	Institute Address	UNIVERSITY OF KALYANI DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING , KALYANI, DIST.- NADIA, WEST BENGAL, PIN -741235, KALYANI, NADIA, West Bengal, 741235
Name of the Society/Trust	UNIVERSITY OF KALYANI	Society/Trust Address	UNIVERSITY OF KALYANI, DEPT OF COMPUTER SCIENCE AND ENGINEERING,,KALYANI,NADIA,West Bengal,741235
Institute Type	Govt aided	Region	Eastern

Opted for change from Women to Co-ed and Vice versa	No	Opted for change of name	No	Opted for change of site	No
Change from Women to Co-ed approved and Vice versa	Not Applicable	Change of name Approved	Not Applicable	Change of site Approved	Not Applicable
Opted for Conversion from degree to diploma	No	Opted for Conversion from diploma to degree	No	Conversion (degree to diploma or vice-a-versa) Approved	Not Applicable

To conduct following courses with the intake indicated below for the academic year 2017-18

Application Id: 1-3324188111			Course	Full/Part Time	Affiliating Body	Intake Approved for 2016-17	Intake Approved for 2017-18	NRI Approval status	PIO / FN / Gulf quota/ OCI/ Approval status	Foreign Collaborarion/Twining Program Approval status
Program	Shift	Level								
ENGINEERIN	1st Shift	POST	COMPUTER SCIENCE AND	FULL TIME	Kalyani University,	18	18	NA	NA	NA

G AND TECHNOLOGY		GRADUATE	ENGINEERING		Nadia					
MCA	1st Shift	POST GRADUATE	MASTERS IN COMPUTER APPLICATIONS	FULL TIME	Kalyani University, Nadia	30	30	NA	NA	NA

The above mentioned approval is subject to the condition that
UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
shall follow and adhere to the Regulations, guidelines and directions issued by AICTE from time to time and the undertaking / affidavit given by the institution along with the application submitted by the institution on portal.

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Strict compliance of Anti-Ragging Regulation:- Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

Note: Validity of the course details may be verified at www.aicte-india.org

Prof. A.P Mittal
Member Secretary, AICTE

Copy to:

1. **The Regional Officer,**
   All India Council for Technical Education
   College of Leather Technology Campus
   Block LB, Sector III, Salt Lake City
   Kolkata - 700 098, West Bengal
2. **The Director Of Technical Education**,**
   West Bengal
3. **The Registrar**,**
   Kalyani University, Nadia
4. **The Principal / Director,**
   UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
   UNIVERSITY OF KALYANI
   DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING ,
   KALYANI, DIST.- NADIA,
   WEST BENGAL,
   PIN -741235,
   KALYANI,NADIA,
   West Bengal,741235

5. **The Secretary / Chairman,**
UNIVERSITY OF KALYANI
UNIVERSITY OF KALYANI,
DEPT OF COMPUTER SCIENCE AND ENGINEERING,,
KALYANI,NADIA,
West Bengal,741235

6. **Guard File(AICTE)**

Note: ** - Approval letter copy will not be communicated through post/email. However, provision is made in the portal for downloading Approval letter through Authorized login credentials allotted to concerned DTE/Registrar.

All India Council for Technical Education

(A Statutory body under Ministry of HRD, Govt. of India)

Nelson Mandela Marg,Vasant Kunj, New Delhi-110070 Website: www.aicte-india.org

APPROVAL PROCESS 2018-19

Extension of Approval (EoA)

F.No. Eastern/1-3509314161/2018/EOA

Date: 04-Apr-2018

To,

The Secretary (Technical education)
Govt. of West Bengal,
Bikash Bhawan, Room No. 602,
6th Floor Salt Lake, Kolkata-700091

Sub: Extension of Approval for the Academic Year 2018-19

Ref: Application of the Institution for Extension of approval for the Academic Year 2018-19

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2016 notified by the Council vide notification number F.No.AB/AICTE/REG/2016 dated 30/11/2016 and amended on December 5, 2017 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

Permanent Id	1-4703201	**Application Id**	1-3509314161
Name of the Institute	UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING	**Name of the Society/Trust**	UNIVERSITY OF KALYANI
Institute Address	UNIVERSITY OF KALYANI DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING , KALYANI, DIST.- NADIA, WEST BENGAL, PIN -741235, KALYANI, NADIA, West Bengal, 741235	**Society/Trust Address**	UNIVERSITY OF KALYANI, DEPT OF COMPUTER SCIENCE AND ENGINEERING,,KALYANI,NADIA,West Bengal,741235
Institute Type	Govt aided	**Region**	Eastern

Opted for Change from Women to Co-Ed and vice versa	No	**Change from Women to Co-Ed and vice versa Approved or Not**	NA
Opted for Change of Name	No	**Change of Name Approved or Not**	NA
Opted for Change of Site	No	**Change of Site Approved or Not**	NA
Opted for Conversion from Degree to Diploma or vice versa	No	**Conversion for Degree to Diploma or vice versa Approved or Not**	NA
Opted for Organization Name Change	No	**Change of Organization Name Approved or Not**	NA

To conduct following Courses with the Intake indicated below for the Academic Year 2018-19

Program	Shift	Level	Course	FT/PT+	Affiliating Body (Univ/Body)	Intake Approved for 2018-19	NRI Approval Status	PIO / FN / Gulf quota/ OCI/ Approval Status	Foreign Collaboration /Twining Program Approval Status*
ENGINEERING AND TECHNOLOGY	1st	POST GRADUATE	COMPUTER SCIENCE AND ENGINEERING	FT	Kalyani University, Nadia	18	NA	NA	NA
MCA	1st	POST GRADUATE	MASTERS IN COMPUTER APPLICATIONS	FT	Kalyani University, Nadia	30	NA	NA	NA

+FT –Full Time,PT-Part Time

Deficiencies Noted based on Self Disclosure	
Particulars	**Deficiency**
Other Details Deficiency	
List of faculty and data uploaded on the Institute web portal	Yes
Other Facilities Deficiency	
Standalone Language Laboratory	Yes
Insurance for Students	Yes
Administrative Area Deficiency	
Office All Inclusive	Yes
Faculty Deficiency	Yes
Computational Facilities	
Legal Application S/W	Yes
Legal Application S/W-Applied Intake	Yes
Library Facilities	
Instructional Area Common Facilities	
Language Laboratory	Yes
Instructional Area- MCA	
Drawing Halls	Yes
Seminar Hall	Yes
Laboratories-All	Yes
Seminar Hall	Yes

*Please refer Deficiency Report for details

UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING is hereby informed to submit the compliance of the deficiencies mentioned above to the Regional Office within a period of **6 months** from the date of issuance of this letter failing which the council shall initiate strict action as defined in Approval Process Handbook 2018-19 during the subsequent Academic Year.

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Strict compliance of Anti-Ragging Regulation: - Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

Prof. A.P Mittal
Member Secretary, AICTE

Copy to:

1. The Regional Officer,
   All India Council for Technical Education
   College of Leather Technology Campus
   Block LB, Sector III, Salt Lake City
   Kolkata - 700 098, West Bengal
2. The Director Of Technical Education**,
   West Bengal
3. The Registrar**,
   Kalyani University, Nadia
4. The Principal / Director,
   UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
   UNIVERSITY OF KALYANI
   DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING ,
   KALYANI, DIST.- NADIA,

WEST BENGAL,
PIN -741235,
KALYANI,NADIA,
West Bengal,741235

5. The Secretary / Chairman,
UNIVERSITY OF KALYANI
UNIVERSITY OF KALYANI,
DEPT OF COMPUTER SCIENCE AND ENGINEERING,,
KALYANI,NADIA,
West Bengal,741235

6. Guard File(AICTE)

Note: Validity of the Course details may be verified at http://www.aicte-india.org/

** Individual Approval letter copy will not be communicated through Post/Email. However, consolidated list of Approved Institutions(bulk) will be shared through official Email Address to the concerned Authorities mentioned above.

All India Council for Technical Education

(A Statutory body under Ministry of HRD, Govt. of India)

Nelson Mandela Marg,Vasant Kunj, New Delhi-110070 Website: www.aicte-india.org

APPROVAL PROCESS 2019-20

Extension of Approval (EoA)

F.No. Eastern/1-4259625006/2019/EOA

Date: 25-Apr-2019

To,

The Secretary (Technical education)
Govt. of West Bengal,
Bikash Bhawan, Room No. 602,
6th Floor Salt Lake, Kolkata-700091

Sub: Extension of Approval for the Academic Year 2019-20

Ref: Application of the Institution for Extension of approval for the Academic Year 2019-20

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2018 notified by the Council vide notification number F.No.AB/AICTE/REG/2018 dated 31/12/2018 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

Permanent Id	1-4703201	**Application Id**	1-4259625006
Name of the Institute	UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING	**Name of the Society/Trust**	UNIVERSITY OF KALYANI
Institute Address	UNIVERSITY OF KALYANI DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING , KALYANI, DIST.- NADIA, WEST BENGAL, PIN -741235, KALYANI, NADIA, West Bengal, 741235	**Society/Trust Address**	UNIVERSITY OF KALYANI, DEPT OF COMPUTER SCIENCE AND ENGINEERING,,KALYANI,NADIA,West Bengal,741235
Institute Type	Govt aided	**Region**	Eastern

Opted for Change from Women to Co-Ed and vice versa	No	**Change from Women to Co-Ed and vice versa Approved or Not**	NA
Opted for Change of Name	No	**Change of Name Approved or Not**	NA
Opted for Change of Site/Location	No	**Change of Site/Location Approved or Not**	NA
Opted for Conversion from Degree to Diploma or vice versa	No	**Conversion for Degree to Diploma or vice versa Approved or Not**	NA
Opted for Organization Name Change	No	**Change of Organization Name Approved or Not**	NA
Opted for Merger of Institution	No	**Merger of Institution Approved or Not**	NA
Opted for Introduction of New Program/Level	No	**Introduction of Program/Level Approved or Not**	NA

To conduct following Courses with the Intake indicated below for the Academic Year 2019-20

Program	Shift	Level	Course	FT/PT+	Affiliating Body (Univ/Body)	Intake Approved for 2019-20	NRI Approval Status	PIO / FN / Gulf quota/ OCI/ Approval Status
Engineering And Technology	1st	POST GRADUATE	Computer Science And Engineering	FT	Kalyani University, Nadia	10	NA	NA

Mca	1st	POST GRADUATE	Masters In Computer Applications	FT	Kalyani University, Nadia	15	NA	NA

+FT –Full Time,PT-Part Time

Deficiencies Noted based on Self Disclosure

Particulars	Deficiency
Other Facilities Deficiency	
Standalone Language Laboratory	Yes
Insurance for Students	Yes
Fire and Safety Certificate	Yes
Mandatory internship policy for students	Yes
Atleast 5 MoUs with industries	Yes
Computational Facilities	
Number of PCs in Language lab	Yes
Instructional Area Common Facilities	
Language Laboratory	Yes
Instructional Area- MCA	
Drawing Halls	Yes

*Please refer Deficiency Report for details

UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING is hereby informed to submit the compliance of the deficiencies mentioned above to the Regional Office within a period of **6 months** from the date of issuance of this letter failing which the council shall initiate strict action as defined in Approval Process Handbook 2019-20 during the subsequent Academic Year.

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Strict compliance of Anti-Ragging Regulation: - Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

It is mandatory to comply all the essential requirements as given in APH 2019-20(appendix 6)

NOTE: If the State Government / UT / DTE / DME has a reservation policy for admission in Technical Education Institutes and the same is applicable to Private & Self-financing Technical Institutions, then the State Government / UT/ DTE / DME shall ensure that 10 % of Reservation for EWS would be operational from the Academic year 2019-20 without affecting the percentage reservations of SC/ST/OBC/General . However, this would not be applicable in the case of Minority Institutions referred to the clause (1) of Article 30 of Constitution of India.

Prof. A.P Mittal
Member Secretary, AICTE

Copy to:

1. **The Director Of Technical Education**, West Bengal**

2. **The Registrar**,**
   Kalyani University, Nadia

3. **The Principal / Director,**
   University Of Kalyani, Department Of Computer Science And Engineering
   University Of Kalyani
   Department Of Computer Science And Engineering ,

Kalyani, Dist.- Nadia,
West Bengal,
Pin -741235,
Kalyani,Nadia,
West Bengal,741235

4. **The Secretary / Chairman,**
University Of Kalyani
University Of Kalyani,
Dept Of Computer Science And Engineering,.
Kalyani,Nadia,
West Bengal,741235

5. **The Regional Officer,**
All India Council for Technical Education
College of Leather Technology Campus
Block LB, Sector III, Salt Lake City
Kolkata - 700 098, West Bengal

6. **Guard File(AICTE)**

Note: Validity of the Course details may be verified at http://www.aicte-india.org/

** Individual Approval letter copy will not be communicated through Post/Email. However, consolidated list of Approved Institutions(bulk) will be shared through official Email Address to the concerned Authorities mentioned above.

All India Council for Technical Education

(A Statutory body under Ministry of HRD, Govt. of India)

Nelson Mandela Marg,Vasant Kunj, New Delhi-110070 Website: www.aicte-india.org

APPROVAL PROCESS 2020-21

Extension of Approval (EoA)

F.No. Eastern/1-7012580902/2020/EOA Date: 09-Jun-2020

To,

The Secretary (Technical education)
Govt. of West Bengal,
Bikash Bhawan, Room No. 602,
6th Floor Salt Lake, Kolkata-700091

Sub: Extension of Approval for the Academic Year 2020-21

Ref: Application of the Institution for Extension of Approval for the Academic Year 2020-21

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2020 notified by the Council vide notification number F.No. AB/AICTE/REG/2020 dated 4th February 2020 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

Permanent Id	1-4703201	**Application Id**	1-7012580902
Name of the Institute	UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING	**Name of the Society/Trust**	UNIVERSITY OF KALYANI
Institute Address	UNIVERSITY OF KALYANI DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING , KALYANI, DIST.- NADIA, WEST BENGAL, PIN -741235, KALYANI, NADIA, West Bengal, 741235	**Society/Trust Address**	UNIVERSITY OF KALYANI, DEPT OF COMPUTER SCIENCE AND ENGINEERING,,KALYANI,NADIA,, 741235
Institute Type	Govt aided	**Region**	Eastern

To conduct following Courses with the Intake indicated below for the Academic Year 2020-21

Program	Level	Course	Affiliating Body (University /Body)	Intake Approved for 2019-20	Intake Approved for 2020-21	NRI Approval Status	PIO / FN / Gulf quota/ OCI/ Approval Status
ENGINEERING AND TECHNOLOGY	POST GRADUATE	COMPUTER SCIENCE AND ENGINEERING	Kalyani University, Nadia	10	18	NA	NA
MCA	POST GRADUATE	MASTERS IN COMPUTER APPLICATIONS	Kalyani University, Nadia	15	30	NA	NA

It is mandatory to comply with all the essential requirements as given in APH 2020-21 (Appendix 6)

The Institution/ University is having the following deficiencies as per the online application submitted to AICTE and the same shall be complied within Six Months from the date of issue of this EoA

Deficiencies Noted based on Self Disclosure	
Particulars	**Deficiency**
1. Other Facilities Deficiency	
Atleast 5 MoUs with industries	Yes

*Please refer Deficiency Report for details

Important Instructions

1. The State Government/ UT/ Directorate of Technical Education/ Directorate of Medical Education shall ensure that 10% of reservation for Economically Weaker Section (EWS) as per the reservation policy for admission, operational from the Academic year 2020-21 is implemented without affecting the reservation percentages of SC/ ST/ OBC/ General. However, this would not be applicable in the case of Minority Institutions referred to the Clause (1) of Article 30 of Constitution of India. Such Institution shall be permitted to increase in annual permitted strength over a maximum period of two years beginning with the Academic Year 2020-21

2. The Institution offering courses earlier in the Regular Shift, First Shift, Second Shift/Part Time now amalgamated as total intake shall have to fulfil all facilities such as Infrastructure, Faculty and other requirements as per the norms specified in the Approval Process Handbook 2020-21 for the Total Approved Intake. Further, the Institutions Deemed to be Universities/ Institutions having Accreditation/ Autonomy status shall have to maintain the Faculty: Student ratio as specified in the Approval Process Handbook. All such Institutions/ Universities shall have to create the necessary Faculty, Infrastructure and other facilities WITHIN 2 YEARS to fulfil the norms based on the Affidavit submitted to AICTE.

3. In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

4. Strict compliance of Anti-Ragging Regulation: - Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 373/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

Prof.Rajive Kumar
Member Secretary, AICTE

Copy to:

1. **The Director Of Technical Education**, West Bengal**

2. **The Registrar**,**
   Kalyani University, Nadia

3. **The Principal / Director,**
   UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
   University Of Kalyani
   Department Of Computer Science And Engineering ,
   Kalyani, Dist.- Nadia,
   West Bengal,
   Pin -741235,
   Kalyani,Nadia,
   West Bengal,741235

4. **The Secretary / Chairman,**
UNIVERSITY OF KALYANI,
DEPT OF COMPUTER SCIENCE AND ENGINEERING,
KALYANI,NADIA
,741235

5. **The Regional Officer,**
All India Council for Technical Education
College of Leather Technology Campus
Block LB, Sector III, Salt Lake City
Kolkata - 700 098, West Bengal

6. **Guard File(AICTE)**

Note: Validity of the Course details may be verified at http://www.aicte-india.org/

** Individual Approval letter copy will not be communicated through Post/Email. However, consolidated list of Approved Institutions(bulk) will be shared through official Email Address to the concerned Authorities mentioned above.

All India Council for Technical Education

(A Statutory body under Ministry of Education, Govt. of India)

Nelson Mandela Marg,Vasant Kunj, New Delhi-110070 Website: www.aicte-india.org

APPROVAL PROCESS 2021-22

Extension of Approval (EoA)

F.No. Eastern/1-9317986394/2021/EOA

Date: 25-Jun-2021

To,

The Secretary (Technical education)
Govt. of West Bengal,
Bikash Bhawan, Room No. 602,
6th Floor Salt Lake, Kolkata-700091

Sub: Extension of Approval for the Academic Year 2021-22

Ref: Application of the Institution for Extension of Approval for the Academic Year 2021-22

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations, 2021 Notified on 4th February, 2020 and amended on 24th February 2021 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to:

Permanent Id	1-4703201	**Application Id**	1-9317986394
Name of the Institution /University	UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING	**Name of the Society/Trust**	UNIVERSITY OF KALYANI
Institution /University Address	UNIVERSITY OF KALYANI DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING , KALYANI, DIST.- NADIA, WEST BENGAL, PIN -741235, KALYANI, NADIA, West Bengal, 741235	**Society/Trust Address**	UNIVERSITY OF KALYANI, DEPT OF COMPUTER SCIENCE AND ENGINEERING,,KALYANI,NADIA, West Bengal,741235
Institution /University Type	Govt aided	**Region**	Eastern

To conduct following Programs / Courses with the Intake indicated below for the Academic Year 2021-22

Program	Level	Course	Affiliating Body (University /Body)	Intake Approved for 2020-21	Intake Approved for 2021-22	NRI Approval Status	FN / Gulf quota/ OCI/ Approval Status
ENGINEERING AND TECHNOLOGY	POST GRADUATE	COMPUTER SCIENCE AND ENGINEERING	Kalyani University, Nadia	18	18	NA	NA
MCA	POST GRADUATE	MASTERS IN COMPUTER APPLICATIONS	Kalyani University, Nadia	30	30	NA	NA

It is mandatory to comply with all the essential requirements as given in APH 2021-22 (Appendix 6)
The Institution/ University is having the following deficiencies as per the online application submitted to AICTE (self-disclosure based) and the same shall be complied within Six Months from the date of issue of this EoA

Deficiencies* Noted (based on Self Disclosure)
Atleast 5 MoUs with industries.

*Please refer Deficiency Report for details

Important Instructions

1. The State Government/ UT/ Directorate of Technical Education/ Directorate of Medical Education shall ensure that 10% of reservation for Economically Weaker Section (EWS) as per the reservation policy for admission, operational from the Academic year 2019-20 is implemented without affecting the reservation percentages of SC/ ST/ OBC/ General. However, this would not be applicable in the case of Minority Institutions referred to the Clause (1) of Article 30 of Constitution of India. Such Institution shall be permitted to increase in annual permitted strength over a maximum period of two years.

2. The Institution offering courses earlier in the Regular Shift, First Shift, Second Shift/Part Time now amalgamated as total intake shall have to fulfil all facilities such as Infrastructure, Faculty and other requirements as per the norms specified in the Approval Process Handbook 2021-22 for the Total Approved Intake. Further, the Institutions Deemed to be Universities/ Institutions having Accreditation/ Autonomy status shall have to maintain the Faculty: Student ratio as specified in the Approval Process Handbook.

3. Strict compliance of Anti-Ragging Regulation, Establishment of Committee for SC/ ST, Establishment of Internal Complaint Committee (ICC), Establishment of Online Grievance Redressal Mechanism, Barrier Free Built Environment for disabled and elderly persons, Fire and Safety Certificate should be maintained as per the provisions made in Approval Process Handbook and AICTE Regulation notified from time to time.

4. In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Prof.Rajive Kumar
Member Secretary, AICTE

Copy ** to:

1. **The Director of Technical Education**, West Bengal**

2. **The Registrar**,**
   Kalyani University, Nadia

3. **The Principal / Director,**
   UNIVERSITY OF KALYANI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
   University Of Kalyani
   Department Of Computer Science And Engineering ,
   Kalyani, Dist.- Nadia,
   West Bengal,
   Pin -741235,
   Kalyani,Nadia,
   West Bengal,741235

4. **The Secretary / Chairman,**
   UNIVERSITY OF KALYANI,
   DEPT OF COMPUTER SCIENCE AND ENGINEERING,
   KALYANI,NADIA
   West Bengal,741235

5. **The Regional Officer,**
   All India Council for Technical Education
   College of Leather Technology Campus
   Block LB, Sector III, Salt Lake City
   Kolkata - 700 098, West Bengal

6. **Guard File(AICTE)**

Note: Validity of the Course details may be verified at http://www.aicte-india.org/ .

** Individual Approval letter copy will not be communicated through Post/Email. However, consolidated list of Approved Institutions(bulk) will be shared through official Email Address to the concerned Authorities mentioned above.

This is a computer generated Statement. No signature Required

19. Account audited statement :

UNIVERSITY OF KALYANI					
Income & Expenditure Statement for 2017-18					
Income			Expenditure		
Sl. No.	Details	Amount	Sl. No.	Details	Amount
1	Tuition Fees	15237580.00	1	Salary & Pension (including retirement benefit)	598164919.00
2	Other fee/amount collected from students	87252453.00	2	Administrative expenses	156671738.00
3	Grants from Govt. / Private agencies	788814413.00	3	Training and Development	793374.00
4	Grants / Contribution from other sources (Management)		4	Laboratory consumables	22155969.00
5	Scholarships received	11740581.00	5	Library	8431046.00
6	Other income	79582929.00	6	Travel	860575.00
			7	Fees Paid to University/ Board/ Government/AICTE/UGC	
			8	Repairs and Maintenance	21297028.00
			9	Scholarships/ Concessions/ Fellowships/Honorarium etc., awarded/incurred(other than Govt. grants)	11740581.00
			10	Expenditure of grants received from Govt. / Private agencies	64207339.00
			11	Depreciation	14325141.00
			12	Any other expenditure	70717856.00
	Total	982627956.00		Total	969365566.00

Finance Officer 28/1/19.

Finance Officer
University of Kalyani

AUDITED STATEMENT OF ACCOUNT OF 2018-19 (Income & Expenditure Statement for Complete Year)					
Rupees in Lakhs					
Sl.No.	Income	Amount (Rs.)	Sl.No.	Expenditure	Amount (Rs.)
1	Income from Central Govt.		1	Salary Teaching Staff	2827.51
2	Income from State Govt.	7512.51	2	Remuneration to visiting/Guest	113.58
3	Income from Student Fees	204.08	3	Salary non-teaching staff	1156.97
4	Income from Donation		4	Library	120.12
5	Income from UGC	41.77	5	Equipment	89.65
6	Scheme Project	659.49	6	Builidng Maintenance	460.77
7	Income from Other/Internal Revenue	1346.16	7	Other Expenditure	1795.61
			8	Scheme Project	744.88
			9	Pension & Retirment Benefit	2252.65
	Total	9764.01		Total	9561.74

21.11.19.

Finance Officer
University of Kalyani

AUDITED STATEMENT OF ACCOUNT OF 2019-20 (INCOME & EXPENDITURE STATEMENT FOR COMPLETE YEAR)

SL.NO.	INCOME	Amount (Rs.)	SL. NO.	EXPENDITURE	Amount (Rs.)
1	TUITION FEES	12,727,340.00	1	SALARY	713,875,637.50
2	OTHER FEE/AMOUNT COLLECTED FROM STUDENTS	85,656,086.51	2	ADMINISTRATIVE EXPENDITURE (EXCLUDING SALARY)	201,533,620.00
3	STATE GOVT.GRANT	767,477,000.00	3	BUILDING	21,869,369.00
4	AFFILIATION AND APPLICATION FEES	6,243,828.00	4	EQUIPMENT & SOFTWARE	1,883,843.00
5	RECEIVED FROM RUSA DIRECTORATE	75,000,000.00	5	FURNITURE	3,878,876.00
6	RECEIVED FROM UGC FOR XII PLAN DEVELOPMENT GRANT	5,000,000.00	6	TRAINING AND DEVELOPMENT	19,437,792.00
7	STATE GOVT.GRANT FOR DEVELOPMENT PURPOSE	19,181,620.00	7	LABORATORY CONSUMABLE	19,359,780.00
9	SCHEME & PROJECTS	47,649,556.00	8	LIBRARY	15,227,070.00
10	OTHER INCOME	18,820,626.92	9	TRAVEL	31,519.00
11	DODL RECEIPTS	74,979,900.00	10	SCHEME & PROJECT	40,432,464.24
			11	DODL EXPENDITURE	29,376,355.00
					1,066,906,325.74
	Total	**1,112,735,957.43**		**Surplus**	**45,829,631.69**
				Total	**1,112,735,957.43**

Finance Officer
University of Kalyani

Finance Officer
University of Kalyani

20. Best Practices adopted, if any:

The department is involved in many innovative ideas, practices and extension activities. Some important activities are as follows:

- The department has a dedicated website (http://kucse.in) and a Facebook page.
- The department takes students' feedback on different courses at the end of each semester through online portal.
- The syllabi of each course is updated on regular basis to incorporate the latest updates from industries and to facilitate students for qualifying NET/SET examinations.
- Modern teaching aids like LCD projectors are used in classes.
- The department houses a Finishing School funded by Govt. of West Bengal, where different training programs are conducted for school teachers of Nadia and Murshidabad district.
- All the old computers of the department are given to other departments of the university for their use.

21. Accreditation status

NBA Accreditation Status		
1	Name/ List of Programmes/ Courses Accredited	NA
2	Applied for Accreditation	NA
	A. Applied but Visit not happened	
	B. Visit happened but result awaited	
3	List of programmes/ courses Not Applied	NA

NAAC Accreditation Status		
1	Accredited	A Grade
2	Applied for Accreditation	
	A. Applied but Visit not happened	
	B. Visit happened but result awaited	
3	Not Applied	