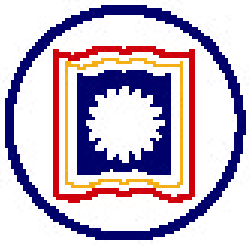
University of Rajshahi

Department of Information and Communication Engineering

Faculty of Engineering



Syllabus for Master of Engineering
in
Information and Communication Engineering
M. Engg. (ICE)

Session: 2014-15

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URL: http://www.dept.ru.ac.bd/ice

The M. Engg. program in Information and Communication Engineering shall have a minimum duration of three semesters of 6 (six) months each. The duration of M. Engg. program shall be of 78 weeks, where first semester, second semester and third semester shall be of 19 weeks, 19 weeks and 26 weeks, respectively. A candidate for the M. Engg. degree must complete all requirements for the degree within **three and half** academic years from the date of his/her first admission. A student shall be required to have attended at least 70% of the total number of lectures/tutorials/laboratory classes held to appear as a regular candidate at the semester final examinations.

Degree Requirements

A student must successfully complete the courses of all the semesters within **three and a half academic years** as outlined by the Committee of Courses with all its pre-requisites in order to be eligible for the award of M. Engg. degree in Information and Communication Engineering. The minimum passing grade in a theoretical course will be **D** and the minimum passing grade in a **laboratory/project/field work/in-plant training**, and **viva-voce** course will be **C.** In order to qualify for M. Engg. degree, a student must **earn 60 credit points (i.e. no 'F' grade) and the CGPA** of the student must be **2.25 or highe**r.

Duration of Course and Course Structure

(i) The minimum duration of the M. Engg. program shall be three semesters of 6 (six) months each. A candidate for the M. Engg. degree must complete all requirements for the degree within **three and half** academic years from the date of his/her first admission.

(ii) Teaching for the courses is reckoned in terms of credits within the following guidelines:

Nature of course	**Contact hour (for 1 credit)**
Theoretical Lecture	: 1 hour a week
Laboratory/sessional	: 2 - 3 hours a week
Project	: 2 – 3 hours a week
Field work/In-plant training	: 4 days of field work

For other fractions of credit, proportionality shall be applied.

(iii) **Total Hours/week:** The total teaching hours including lecture, tutorial and laboratory shall be between **24 - 42** hours per week.

(iv) **Course Advisor**: One of the teachers of the department shall act as **Course Advisor** for each of the three semesters of a batch.

Academic Calendar

(i) The minimum duration of the M. Engg. program shall be three semesters, duration of each semester shall be **not less than 11 teaching weeks**.

(ii) There shall be final examination at the end of each semester.

(iii) **Academic schedule** for general notification shall be published before the start of the 1st semester. The schedule may be prepared according to the following guidelines:

1st Semester (19 weeks)	**Number of weeks**
Teaching	11 (66 working days)
Preparatory Leave	2
Examination Period	2 - 3
Results Publication	3 - 4
Total:	**19**

Vacation including Inter-Semester Recess	1 week

2nd Semester (19 weeks)	Number of weeks
Teaching	11 (66 working days)
Preparatory Leave	2
Examination Period	2 - 3
Results Publication	3 - 4
Total:	**19**

Vacation (Summer, Ramadan, and Others) including Inter-Session Break.	13 weeks
(1st Semester+2nd Semester) Total:	**52 weeks**

3rd Semester (26 weeks)	Number of weeks
Teaching	11 (66 working days)
Preparatory Leave	2
Examination Period	3 - 4
Results Publication	9 - 10
Total:	**26**

(1st Semester+2nd Semester+3rd Semester) Total:	**78 weeks**

Attendance

(i) In order to be eligible for appearing at the semester final examination as a regular candidate, a student shall be required to have attended at least 70% of the total number of lectures/tutorials/laboratory classes held in the semester. The laboratory courses mean all laboratory/project/fieldwork/in-plant training or similar courses.

(ii) A student whose attendance is 60% to less than 70% in any **course** may be allowed to appear at the final examinations as an irregular student but **he/she shall not be eligible for any scholarship or stipend.**

(iii) Student having **less than 60% attendance will not be allowed to appear** at the final examinations of the semester.

(iv) The percentage of attendance of the readmitted students shall be counted from the date of the start of the semester or from his/her previous attendance of the semester.

Striking off the Names and Readmission

(i) The names of the students shall be struck off and removed from the rolls on the following grounds:
   (1) Non-payment of University fees and dues within the prescribed period,
   (2) Failing to get himself/herself promoted to the next higher semester,
   (3) Forced to discontinue **his/her** studies under disciplinary rules,
   (4) Withdrawal of names from the rolls of the University on grounds acceptable to the Vice-Chancellor of the University after having cleared all dues.

(ii) In case a student, whose name has been struck off the rolls under clause (i.1) seeks readmission **before the start of the next semester** he/she shall be readmitted on payment of all the fees and dues. But if he/she seeks readmission in any subsequent **semester**, the procedure for his/her readmission will be the same as described under **clause** (iv) below.

(iii) In case a student, whose name has been struck off the rolls under clause (i.2) seeks readmission **before the start of the next semester** he/she shall be readmitted on the approval of the relevant department on payment of all the arrear fees and dues.

(iv) A Student, whose name has been struck off the rolls by exercise of the clause (i.3), seeking readmission after expiry of the suspension period, shall submit an application to the Chairman of the Department before the commencement of the semester to which he/she seeks re-admission. The Chairman of the Department shall forward the application to the Vice-Chancellor. In case the readmission is allowed, the student will be readmitted on payment of all the fees and dues within one week from the date of permission given by the Vice-Chancellor.

(v) In case of any application for readmission is rejected, the student may appeal to the

Academic Council for re-consideration. **The decision of the Academic Council shall be final.**

(vi) No student who has withdrawn his/her name under clause (i.4) shall be given readmission.

(vii) All readmission should preferably be completed before the semester starts.

(viii) The application of a student for readmission will only be considered if he/she applies within **one year** from the date he/she discontinued his/her studies in the University. **The maximum period of studies** for M. Engg. degree under **no circumstances will exceed three and half academic years.**

Grading System

(i) The letter grade system for assessing the performance of the students shall be as follows:

Numerical grade	Letter Grade (LG)	Grade Point (GP)
80% or above	A+	4.0
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.5
65 to less than 70%	B+	3.25
60% to less than 65%	B	3.0
55% to less than 60%	B-	2.75
50 to less than 55%	C+	2.5
45% to less than 50%	C	2.25
40 to less than 45%	D	2.0
less than 40%	F	0.0
Incomplete	I	0.0

A letter grade I (incomplete) shall be awarded for courses that could not be completed in one semester, which will continue through to the next semester.

(ii) A **Semester wise Grade Point Average (SGPA**) shall be computed for each semester. The SGPA will be calculated as follows:

$$\text{SGPA} = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$$

where, n is the number of courses offered during the semester, C_i is the number of credits allotted to a i'th course and G_i is the i'th grade point corresponding to the grade awarded for that course.

(iii) A Cumulative Grade Point Average (CGPA) shall also be computed at the end of second and third semester in the following way:

$$\text{CGPA} = \frac{\sum_{i=1}^{m} S_i C_i}{\sum_{i=1}^{m} C_i}$$

where, m is the total number of semesters being considered, S_i is the SGPA of a i'th semester, C_i is the total number of credits in i'th semester.

(iv) Both SGPA and CGPA will be rounded off to the second place of decimal for reporting. **For instance, SGPA=2.212 shall be rounded off as SGPA=2.22**

(v) **Earned Credit:** The courses in which a student has obtained minimum 'D' in 'Theoretical courses' and 'C' in 'laboratory/field work/in-plant training and viva voce' will be counted as credits earned by the student. Any course in which a student has earned 'F' grade in theoretical and 'F' and 'D' grades in laboratory/field work/in-plant training and viva voce will not be counted towards his/her earned credit.

Duration of Examination

Duration of **Theoretical examination of different courses** shall be as follows:

Courses of 2 credits or less than 2 credits	2 Hours
Courses of more than 2 credits	3 Hours

Conduct of Examination and Rules for Promotion

(i) The results shall be finalized at the end of the 3rd semester of the program. Individual **course** grades shall be announced within a date ordinarily not later than three weeks after the end of the semester final examinations.

(ii) **Minimum passing grade:** The minimum passing grade in a theoretical course will be D and the minimum passing grade in a laboratory/project/field work/in-plant training and **viva-voce** course will **be C.**

(iii) **Promotion to higher semester:** A student who has a grade point average of **2.2** or higher, F grade in not more than 8 credit points and at least C grade in the laboratory/field work/in-plant training and viva voce courses of the 1st and 2nd semester shall be promoted to the 2nd and 3rd semester, respectively.

(iv) There shall be **no improvement** in laboratory/field work/in-plant training/project and viva voce courses**.** A student failing to secure a **minimum C grade** in any of these courses in any semester shall **fail the semester**.

(v) **Grade Point Improvement**:

1	A promoted student who obtains less than B grade in theoretical courses in any semester, may appear in the upcoming regular examination of that semester to improve the grade points.
2	Grade obtained by a student in the courses in which he/she appeared for improvement will be recorded for final assessment according to clause (v.1) and the grade obtain by him/her in those courses at the regular final examination shall automatically cancelled.
3	Clause (v.2) is not valid for a candidate who cannot improve his/her course grade; in that case the previous grade shall remain valid.
4	A student must clear F grade of the courses of all the semesters.

(vi) **Course Exemption:** Students who fail to be promoted to the 2nd and 3rd semester shall be exempted from taking the theoretical and laboratory courses where they obtained grades **equal to or better than B.** These grades would be counted towards calculating SGPA in the retained semesters.

(vii) **Merit Position:** The SGPA obtained by a regular student in a **semester final examination** will be considered for determining the **merit position for the award of scholarships, stipends etc.**

Class Test

For theoretical courses of **2 or less than 2 credits** there shall be at **least three** class tests and at **least four** class tests for **greater than 2 credits in a** semester.

Publication of Results

(i) A student must successfully complete the courses of all the semesters within **three and a half academic years** as outlined by the Committee of Courses with all its pre-requisites in order to be eligible for the award of M.Engg. degree. The student must **earn 60 credit points (i.e. no 'F' grade) and the CGPA** for the student must be **2.25 or highe**r.

(ii) The final merit position will be based on CGPA.

(iii) **Dean's List:** As a recognition of excellent performance, the names of students obtaining a CGPA of 3.75 or above in two regular semesters in each academic year may be published in the Dean's List in the faculty. Students who have received **an 'F' grade** in any course during any of the two regular semesters will not be considered for Dean's List in that year.

Absence in Examination

A candidate absenting himself/herself in a **course** examination of any semester final examination in which he/she ought to have been present, will be considered **'F' grade** in that **course**.

Eligibility for Examination

(i) A candidate may not be admitted to any semester final examination unless he/she has
   1) Submitted to the Registrar/Vice-Chancellor an application in the prescribed form for appearing at the examination.
   2) Paid the prescribed examination fees, and outstanding of all University and Hall dues.
   3) Fulfilled the conditions for attendance in class.
   4) Not barred by any disciplinary rule.

(ii) On special circumstances the Vice-Chancellor may permit a student to appear at the examination.

Syllabus for M. Engg. (ICE) 2014-15

Courses offered to the M. Engg. Students of the Department of Information and Communication Engineering

Distribution of Courses

Course Type for M. Engg. (ICE)	Credit Distribution
Theoretical	36
Practical	16
Project	4
Board Viva-voce	4
Total credits	**60**

Credits Distribution (Semester-wise)

Semester	Nature of Course M.Engg. (ICE)	Credits Distribution
1st semester	Theoretical	12
	Practical	6
	Total	**18**
2nd semester	Theoretical	16
	Practical	6
	Total	**22**
3rd semester	Theoretical	8
	Practical	4
	Project	4
	Board Viva-voce	4
	Total	**20**
(1st semester+2nd semester+3rd semester)	**Total**	**60**

Course Code and Course Title for M. Engg. (ICE) 2014-15

Semester	Course Code	Course Title	Credits	Marks
1st Semester	ICE M1011	Stochastic Theory of Communication	4	100
	ICE M1012	Stochastic Theory of Communication Lab	2	50
	ICE M1021	Advanced Wireless Communication and Networks	4	100
	ICE M1022	Advanced Wireless Communication and Networks Lab	2	50
	ICE M1031	Introduction to Computer Vision	4	100
	ICE M1032	Introduction to Computer Vision Lab	2	50
1st semester Total			**18**	**450**
2nd Semester	ICE M2011	Wireless Sensor Networks	4	100
	ICE M2012	Wireless Sensor Networks Lab	1	25
	ICE M2021	Multimedia Communication	4	100
	ICE M2022	Multimedia Communication Lab	1	25
	ICE M2031	Mathematical Programming	4	100
	ICE M2032	Mathematical Programming Lab	2	50
	ICE M2041	Data Mining	4	100
	ICE M2042	Data Mining Lab	2	50
2nd semester Total			**22**	**550**
3rd Semester	ICE M3011	Advanced Optical Communication and Networks	4	100
	ICE M3012	Advanced Optical Communication and Networks Lab	2	50
	ICE M3021	E-Commerce	4	100
	ICE M3022	E-Commerce Lab	2	50
	ICE M3032	Project	4	100
	ICE M3030	Board Viva-voce	4	100
3rd semester Total			**20**	**500**
(1st semester+2nd semester+3rd semester) Total			**60**	**1500**

1st Semester

ICE M1011: Stochastic Theory of Communication

4 Credits, 100 Marks

Lectures: 66	**Exam Duration: 3 Hours**
Students shall have to answer 6 questions out of 8 questions taking any 3 from each section.	

Section A

Introduction to Probability Theory: Sample space, Events, Set operations, Axioms of probability, Conditional probabilities, Baye's formula.

Random Variables: Basic concepts, Introduction to Bernoulli, Binomial, Geometric, Poisson, Uniform, Exponential, and Normal random variables, Vector and Multiple random variables, Conditional probability and conditional expectation.

Random Process: Definition, Joint distribution of time samples, Mean, Autocorrelation and autocovariance factions, Gaussian and multiple random processes, Discrete and continuous time random processes, Stationary random processes, Continuity, Differential and integration of random processes, Time average of random processes and Ergodic theorems, Fourier series and Karhunen-Loeve expansion.

Section B

Markov Chains: Introduction to Markov processes, Discrete and continuous time Markov processes, Chapman-Kolmogorov equation, Classification of states, Limiting probabilities, Markov chain Monte Carlo methods, Markov decision processes, Applications of Markov chain in communication.

Introduction to Queuing Theory: Preliminaries, Little's formula, Single server queuing systems, Open and closed systems, M/M/1 queue, Multi-server systems, M/M/c, M/M/c/c and M/M/oo systems, M/G/k queuing systems, Burk's and Jackson's theorem, Applications of Queuing theory in communication.

Books Recommended:

1. Probability and Random Processes for Electrical Engineering, Alberto Leon-Garcia.
2. Introduction to probability Models, Sheldon M. Ross.
3. Probability, Random Variables, and Stochastic Processes, Athanasios Papoulis.

ICE M1012: Stochastic Theory of Communication Laboratory

2 Credits, 50 Marks (4 hours/week)

Laboratory experiments based on the theories and concepts as illustrated in **ICE M1011** course.

ICE M1021: Advanced Wireless Communication and Networks

4 Credits, 100 Marks

Lectures: 66	**Exam Duration : 3 Hours**
Students shall have to answer any 6 questions out of 8 questions taking 3 from each section.	

Section A

Preliminaries: Narrow and Wideband Fading Channel models, Digital Modulation Schemes and their comparative performance, Equalization and Diversity Techniques.

Coding for Wireless Channels: Linear Block Codes, Convolutional Codes, Concatenated Codes, Turbo Codes, Low Density Parity Check Codes, Coded Modulation, Unequal Error Protection Codes, Joint Source and Channel Coding.

Multicarrier Wireless Communication: Data Transmission using Multiple Carriers, Multicarrier Modulation with Overlapping subchannels, Mitigation of subcarrier fading, Discrete Implementation of Multicarrier, Challenges in Multi carrier system, OFDM-based wireless network overview, Multicarrier Modulation based Methods, MC-CDMA.

Section B

Wireless Network and Topologies: Introduction, Wireless network topologies: Infrastructure network topology, Ad hoc network topology, Comparison of ad hoc and infrastructure network topologies, Cellular topology: the cellular concept, Cellular hierarchy, Cell fundamentals.

Wireless Network Planning: Signal-to-interference ratio calculation, Capacity expansion techniques, Architectural methods for capacity expansion: Cell splitting, Using directional antennas for cell sectoring, Lee's microcell method, Using overlaid cells, Using smart antennas, Channel allocation techniques and capacity expansion: Fixed channel allocation (FCA), Dynamic channel allocation (DCA), Hybrid channel allocation (HCA), Comparison of FCA, DCA and HCA, Migration to digital systems, Network planning for CDMA systems, Issues in CDMA network planning: managing the noise floor, cell breathing.

Adhoc Wireless Networks: Applications, Design Principles and Challenges, Protocol Layers, Cross-Layer Design, Network Capacity Limits, Energy-Constrained Networks.

Emerging Technologies: 4G and Beyond, Internet of Things, Smart Grid, M2M Communications, Heterogeneous small scale network, Massive MIMO.

Books Recommended:

1. Wireless Communications, Andrea Goldsmith.
2. Principles of Wireless Communication, T. S. Rappaport.
3. Principles of Wireless Networks-A Unified Approach, Kaveh Pahlavan.
4. OFDM-Based Broadband Wireless Networks: Design and Optimization, Hui Liu, Guoqing Li.

ICE M1022: Advanced Wireless Communication and Networks Laboratory

2 Credits, 50 Marks (4 hours/week)

Laboratory experiments based on the theories and concepts as illustrated in **ICE M1021** course.

ICE M1031: Introduction to Computer Vision

4 Credits, 100 Marks

Lectures: 66	**Exam Duration: 3 Hours**
Students shall have to answer 6 questions out of 8 questions taking any 3 from each section.	

Section A

Introduction: Introduction to computer vision, imaging basics.

Digital Image Formation and Low-level Processing: Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Depth Estimation and Multi-camera Views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, RANSAC, 3-D reconstruction framework; Auto-calibration.

Feature Extraction: Edges - Canny edge detection, thresholding and linking, edge thinning, Second-order approaches to edge detection; Line detectors, Corners - Harris and Hessian Affine, Orientation of Histogram, SIFT, SURF, HOG, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters.

Section B

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, Texture Segmentation; Object detection.

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models, SVM; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Motion Analysis: Background Subtraction and Modeling, Optical Flow, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Books Recommended:

1. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer-Verlag London Limited, 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.
3. Multiple View Geometry in Computer Vision, Richard Hartley and Andrew Zisserman, Second Edition, Cambridge University Press, March 2004.
4. Introduction to Statistical Pattern Recognition, K. Fukunaga, Second Edition, Academic Press, Morgan Kaufmann, 1990.
5. Digital Image Processing, R.C. Gonzalez and R.E. Woods, Addison- Wesley, 1992.

ICE M1032: Introduction to Computer Vision Laboratory

2 Credits, 50 Marks (4 hours/week)

Laboratory experiments based on the theories and concepts as illustrated in **ICE M1031** course.

2nd Semester

ICE M2011: Wireless Sensor Networks

4 Credits, 100 Marks

Lectures: 66	**Exam Duration: 3 Hours**
Students shall have to answer 6 questions out of 8 questions taking any 3 from each section.	

Section-A

Introduction: Background of wireless sensor network (WSN) technology, applications of WSN, sensor node architecture, WSN architecture and protocol stack, design principles of WSN.

Physical Layer and Medium Access Control (MAC) aspects: Wireless channel, PHY layer standards, IEEE 802.15.4, fundamentals of MAC protocols, low duty cycle schemes, contention-based schemes, schedule-based schemes.

Link Layer Aspects: Error control, ARQ technique, FEC technique, hybrid technique, framing, naming and addressing issues.

Section-B

Topology Control and Network Layer Aspects: Topology control in flat networks, hierarchical networks, Challenges for routing, data-centric and flat-architectural protocols, hierarchical protocols, geographic routing.

Time Synchronization and Localization: Challenges for time synchronization, time synchronization techniques in WSN, challenges in localization, ranging techniques, range-based localization protocols, range-free localization protocols.

Transport Layer Aspects: Challenges for transport layer, reliable data transport, single packet delivery, block delivery, congestion control and rate control in WSN.

Books Recommended:

1. Protocols and Architectures for Wireless Sensor Networks, Holger Karl and Andreas Willig, John Willey and Sons Ltd.
2. Wireless Sensor Networks, Ian F. Akyildiz and Mehmet Can Vuran, John Willey and Sons Ltd.
3. Wireless Sensor Networks Technology, Protocols and Applications, Kazem Sohraby, Daniel Minoli, and Taieb Znati, John Willey and Sons Ltd.

ICE M2012: Wireless Sensor Networks Laboratory

1 Credit, 25 Marks (2 hours/week)

Laboratory experiments based on the theories and concepts as illustrated in **ICE M2011** course.

ICE M2021: Multimedia Communication

4 Credits, 100 Marks

Lectures: 66	**Exam Duration: 3 Hours**
Students shall have to answer 6 questions out of 8 questions taking any 3 from each section.	

Section A

Multimedia Communication: Multimedia Communication model, Elements of Multimedia Systems, User and Network requirements, Multimedia Terminals, Audio-Visual Integration, Application of Multimedia communication Networks.

Media Digitization: Digitization principles: Text, Image, Audio, Video, Digital media and Signal Processing Elements.

Text and Image Compression: Compression principles, Text compression, Limpel-Ziv-Welsh Coding, Image coding, Image Compression and Format, Digitized Documents and Pictures, JPEG Multimedia System Design.

Multimedia Processing and Communication Standards: Audio Fundamentals, Transform coding, Subband coding, Audio compression: Differential Pulse Code modulation, Adaptive Differential PCM, Adaptive predictive coding, Linear predictive coding, MPEG Audio Coder, Analog and Digital Video Formats, Video Compression Principles, H.261, H.263, MPEG standards.

Section B

Multimedia Database and Distributed Multimedia Systems: MDBMS and its Characteristics, Integration in a Database Model, DMS, Main features of DMS, Networking, Multimedia OS, Distributed Multimedia server, Distributed Multimedia application.

Signaling Protocols and Networking for Multimedia: Protocols for multimedia communication: RTP, RTCP Signaling protocols: SIP, RTSP, QoS issues in networked Multimedia, QoS guarantees, Enhanced QoS: RSVP, DiffServ, Real-time multimedia streaming techniques, Multicast and Rate Control, Network Traffic, Network queue management, Scheduling.

Multimedia Communication Across Networks: Audio/ video packet in the Network Environment, Video transport across generic networks, Multimedia across ATM networks, Multimedia across IP networks and DSLs, IP-based Transport: UDP Vs TCP, Streaming Media with TCP and UDP, Internet access networks and Multimedia Across Wireless.

Books Recommended:

1. Multimedia Communication Systems Techniques, Standards and Networks, K. R. Rao, Zoran S. Boojkovic, Dragorad A. Milovanovic.
2. Multimedia Communications Applications, Networks, Protocols and Standards , Fred Halsall.
3. Multimedia Communications, Jerry D. Gibson.
4. Multimedia System Design, Andleigh, Thakrar.
5. Multimedia Information Networking, Sharda.
6. Multimedia: Making It work, Vaughan.

ICE M2022: Multimedia Communication Laboratory

1 Credit, 25 Marks (2 hours/week)

Laboratory experiments based on the theories and concepts as illustrated in **ICE M2021** course.

ICE M2031: Mathematical Programming

4 Credits, 100 Marks

Lectures: 66	**Exam Duration: 3 Hours**
Students shall have to answer 6 questions out of 8 questions taking any 3 from each section.	

Section A

Mathematical Programming- An Overview: An Introduction to Management Science and Operation Research, Model Specification, Mathematical Formulation of Problems, General and Scientific Solution Method for Operation Research, Geometrical Preview.

Linear Programming- Simplex Method: Introduction, Fundamental Properties of Solutions, The Computational Procedure, Use of Artificial Variables, Solution of Simultaneous Linear Equations, Applications of Simplex Method.

Duality in Linear Programming: Introduction, General Primal-Dual Problem, Formulating a Dual Problem, Primal-Dual Pair in Matrix Form, Duality Theorems, Duality and Simplex Method, Economic Interpretation of Duality.

Section B

Integer Programming: Introduction, Gomory's All I.P.P Method, Fractional Cut Method, Branch-and-bound Method, Applications of Integer Programming.

Advanced Linear Programming: Introduction, Revised Simplex Method, Bounded Variables, Parametric Linear Programming, Linear Fractional Programming.

Nonlinear Programming: Introduction, Formulating a NLPP, General Nonlinear Programming Problem, Constrained Optimization with Equality Constraints and Inequality Constraints, Saddle Point Problems, Saddle Point and NLPP.

Books Recommended:

1. Operation Research, Kanti Swarup, P. K. Gupta and Man Mohon.
2. Applied Mathematical Programming. S. Bradley, A. Hax and T. Magnanti.
3. Non-linear Programming, Theory and Algorithms, Mokhtar S. Bazaraa, Hanif. D. Sherali and C. M. Shetty.
4. Operation Research and Introduction, H. A. Taha.

ICE M2032: Mathematical Programming Laboratory

2 Credits, 50 Marks (4 hours/week)

Laboratory experiments based on the theories and concepts as illustrated in **ICE M2031** course.

ICE M2041: Data Mining

4 Credits, 100 Marks

Lectures: 66	**Exam Duration: 3 Hours**
Students shall have to answer 6 questions out of 8 questions taking any 3 from each section.	

Section A

Data Warehouse: Definition, The compelling need for data warehouse, Data warehouse architecture, 2-tiere, 3-tiere data warehouse, OLAP and Multidimensional data analysis.

Data Mining: Introduction, scope, Types of data, Data processing, Measures of Similarity and dissimilarity, Summary statistics, Data visualization.

Classification: Basic concepts, Decision tree, Attribute Selection measure, Nearest-neighbor classifiers, Bayesian classifier, Naïve Bayes Classifier, Rule-based classifier, Classification by back propagation, ANN, Support vector machine.

Section B

Cluster Analysis: Introduction, Types of clusters, Partitioning Methods, Hierarchical Methods, Density based Methods, Grid-Based and Model-Based Methods, Clustering high dimensional data.

Association Analysis: Basic concept, Frequently item-set generation: The Apriori principles, Candidate Generation, Support Count; Rule generation, Mining various kinds of association rules, Correlation analysis.

Complicated Data Mining: Graph-Based Clustering, Graph mining, Subgraph mining, mining sequential pattern,

Books Recommended:

1. Data Mining Concepts and Techniques, Jiawei Han and Micheline Kamber.
2. Introduction to Data Mining, Pang-Ning Tan,Michael Steinbach,Vipin Kumar.

ICE M2042: Data Mining Laboratory

2 Credits, 50 Marks (4 hours/week)

Laboratory experiments based on the theories and concepts as illustrated in **ICE M2041** course.

3rd semester

ICE M3011: Advanced Optical Communication and Networks

4 Credits, 100 Marks

Lectures: 66	**Exam Duration: 3 Hours**
Students shall have to answer 6 questions out of 8 questions taking any 3 from each section.	

Section A

Introduction: Historical Perspective, General Optical Communication system.

Key Optical Components: Optical fibers, light sources (Optical transmitter), optical filters and multiplexers, optical modulators, photodiodes (Optical receivers).

Signal Propagation in Optical Fiber: optical fiber losses, waveguide theory of optical fiber, nonlinear schrodinger equation for multichannel transmission, Optical channel noise.

Channel Impairment: nonlinear effects to system performance, link power budget.

Modulation Schemes: ASK, FSK, PSK, QAM, DPSK, QDPSK, OFDM for optical communication, direct and coherent detection of optical signal.

Section B

Evolution of Optical network: Wavelength division multiplexing (WDM) Optical Network.

Optical Networking Elements: optical line terminal (OLT), optical network unit (ONU) wavelength converters, optical cross connects, optical add-drop multiplexers, arrayed waveguide gratings (AWG), wavelength routers.

Wide Area Optical Network (WDM-WAN): routing and wavelength assignment, Network Architecture, optical packet switching and optical burst switching, optical Metro Network, Optical core network.

Optical Access Network: PON, FTTH, FTTB, FTTC networks, IP over WDM, Optical CDMA networks, Control and Management of optical network, Optical submarine networks, next generation future optical networks.

Books Recommended:

1. Advanced Optical Communication Systems and Networks, Milorad Cvijetic and Ivan B. Djordjevic, Artech Publisher, University of Arizona.
2. Optical Fiber Communication, Principle and Practice, John Senior, Prentice Hall Publisher.
3. Fiber Optic Communication System, Govind P Agarwal.
4. WDM Technologies, Optical Networks, Achyut Dutta and Masahiko Fujiwara.
5. Optical Switching and Networking Handbook, Regis J. and Bates.
6. Optical Switching Networks, Martin Maier.

ICE M3012: Advanced Optical Communication and Networks Laboratory

2 Credits, 50 Marks (4 hours/week)

Laboratory experiments based on the theories and concepts as illustrated in **ICE M3011** course.

ICE M3021: E-Commerce System

4 Credits, 100 Marks

Lectures: 66	**Exam Duration: 3 Hours**
Students shall have to answer 6 questions out of 8 questions taking any 3 from each section.	

Section A

E-commerce and Internet: Definition of E-Commerce, Advantages and limitations of E-commerce, Myths of E-commerce, Value chain in E-commerce, Integrating E-commerce, Definition of Internet, Benefit and Limitation of Internet, The Beginning of Internet, The making of WWW, Fundamental of URLs and HTTP.

Internet Architecture and Website Hosting: Definition of Network, Information Transfer, Network Hardware and Design Consideration, Intranet and Extranet, Types of client-server Architecture, Blogging, How ISPs really Work, Choosing an ISP, Domain Name Registration.

Website Building and Evaluation: Function of Website, Building Life Cycle, Constructing Website, Design Criteria, and Anatomy of a site, Site Evaluation Criteria, Cookies, Making a Website Usable, Site Content and Traffic Management.

Section B

Internet Marketing: Pros and Cons of Online Shopping, Internet Marketing Technique, The E-Cycle of Internet Marketing, Market Presence, Attracting Customer To Our Site, Tracking Customer, T-Commerce, Customer Relation Management and E-Value, Real World Cash, E-Money, Cyber Cash, NEETBILL, SET, DEBIT Card, CREDIT Card and Smart card.

B2B E-commerce and Web Portal: Definition of Web portal and Web Service, Evaluation of Web portal, Categories and Characteristics of Web portal, Enterprise Portal Technology, B2B Models, B2B Tools-EDI, Legal Issue.

Security Threats: Security in Cyberspace, Designing for Security, How much risks can You Afford?, Virus, Security Protection and Recovery, How to Secure your System, Role of Bio-metrics, Definition of Encryption, Basic Algorithm, Digital Certificate and Signature, Internet Security Protocols.

Books Recommended:

1. Electronic Commerce, Elias M. Awad.
2. Managing Your E-Commerce Business, Kienan.
3. E-Security & You, Sudeep Oberoi.
4. Web Advertising and Marketing, Kueglar.
5. Developing E-Commerce Sites, Sharma.
6. E-Commerce: Strategy, Technologies and Applications, Whiteley.

ICE M3022: E-Commerce System Laboratory

2 Credits, 50 Marks (4 hours/week)

Laboratory experiments based on the theories and concepts as illustrated in **ICE M3021** course.