# Information Engineering

## Course List

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<th>Unit</th>
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<td>IEG 3010</td>
<td>Digital Communications</td>
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<tr>
<td>IEG 3310</td>
<td>Computer Networks</td>
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<td>IEG 4020</td>
<td>Telecommunication Switching and Network Systems</td>
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<td>IEG 4060</td>
<td>Decision Making Methodology</td>
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<tr>
<td>IEG 4100</td>
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<td>IEG 4130</td>
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<td>IEG 4160</td>
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<td>IEG 4180</td>
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<td>IEG 4190</td>
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<td>IEG 5020</td>
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<td>IEG 5030</td>
<td>Satellite Communications</td>
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<tr>
<td>IEG 5050</td>
<td>Communication Technology Seminar I</td>
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<td>IEG 5110</td>
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<td>IEG 5120</td>
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<td>IEG 5124</td>
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<td>IEG 5130</td>
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<td>IEG 5154</td>
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<td>IEG 5160</td>
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<td>IEG 5180</td>
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<td>IEG 5200</td>
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<td>Advanced Topics in Information Processing</td>
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<td>Advanced Topics in Multimedia Systems</td>
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<td>Advanced Topics in Wireless Communications</td>
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<tr>
<td>IEG 5240</td>
<td>Cryptography, Security and E-Commerce</td>
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<tr>
<td>IEG 801T-810T</td>
<td>M.Phil. Thesis Research I, II, III, IV, V, VI, VII, VIII, IX, X</td>
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## III. M.Sc. Programme (Part-time)

<table>
<thead>
<tr>
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<th>Unit</th>
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<tbody>
<tr>
<td>IEG 7000</td>
<td>Computer Networks</td>
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</tr>
<tr>
<td>IEG 7001</td>
<td>Wireless Communication Systems</td>
<td>3</td>
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@ For Ph.D. comprehensive/qualifying examination only.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>IEG 7002</td>
<td>Telecommunication Networks, Regulation and Practices</td>
<td>3</td>
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<td>IEG 7003</td>
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<td>IEG 7004</td>
<td>Traffic Engineering, Performance Evaluation and Quality of Service</td>
<td>3</td>
</tr>
<tr>
<td>IEG 7005</td>
<td>Optical Communication and Lightwave Networks</td>
<td>3</td>
</tr>
<tr>
<td>IEG 7006</td>
<td>System Administration and Network Security</td>
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<tr>
<td>IEG 7007</td>
<td>Multimedia Coding and Processing</td>
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<td>IEG 7008</td>
<td>Multimedia and Distributed Networks</td>
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<tr>
<td>IEG 7009</td>
<td>Advanced Topics in Information Engineering</td>
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<tr>
<td>IEG 7810</td>
<td>Research and Development Project I</td>
<td>1</td>
</tr>
<tr>
<td>IEG 7820</td>
<td>Research and Development Project II</td>
<td>2</td>
</tr>
</tbody>
</table>

**Course Description**

(Unless otherwise specified, all are 3-unit term courses.)

IEG 3010
Digital Communications
Source and channel models. Modulation and detection. Intersymbol interference and equalization, coding, multipath fading, spread spectrum, synchronization. (For Ph.D. comprehensive/qualifying examination only.)

IEG 3310
Computer Networks
Overview of the OSI reference model. Basic concepts and simple analysis of the physical layer, datalink layer, network layer, and transport layer. Local area networks, the medium access sublayer and the Internet sublayer. (For Ph.D. comprehensive/qualifying examination only.)

IEG 4020
Telecommunication Switching and Network Systems
Concepts of switching, transmission, multiplexing and concentration; circuit switch designs; time-space-time switching; packet/ATM switching principles; interconnection networks; multicast switch designs; broadband (ATM) networking; network traffic modelling and control; performance analysis of switch designs and communications networks.

IEG 4030
Optical Communications
Fibre, transmission modes, dispersion, light sources and transmitters, photodiodes and receivers, optical system components, optical amplifiers, photonic switching, modulation and sensitivity, multiplexing schemes, optical links, lightwave network (e.g., FDDI and SONET), video distribution, fiber-in-the-loop.

IEG 4060
Decision Making Methodology
The nature of decision making. Decision theory: value theory, utility theory, human judgement and inference, value of information, Bayesian decision analysis. Introduction to group decision making: Arrow’s Theorem, collective choice, cooperative and non-cooperative models. Decision algorithms and pattern recognition: statistical decision procedures, feature extraction, linear and quadratic classifiers, context-dependent methods, applications in image analysis and machine vision.
IEG 4100
Wireless Communication Systems
Introduction to digital cellular systems; physical characteristics of radio channels, fading channel, advanced digital modulation, spread spectrum technology, diversity techniques, multiple access schemes, mobile network control and management, 2G and 3G standards. Prerequisite: IEG 3010.

IEG 4130
Introduction to Channel Coding and Cryptography

IEG 4140
Teletraffic Engineering

IEG 4160
Image and Video Processing
Two-dimensional signal processing, image enhancement, image restoration, image and video coding. Image and video content recognition and analysis, with introduction to texture image analysis, general two-dimensional shape recognition, Chinese character recognition, and human face recognition.

IEG 4180
Network Software Design and Programming
This is a project-oriented course that teaches the development of network applications. Subject areas include object-oriented programming (C++ and Java); message-driven programming (windows); client-server systems design; interprocess communication; sockets: blocking and nonblocking I/O; multithreaded process; interactive and concurrent server designs; system-throughput bottlenecks; multimedia over network. Case studies: FTP, RPC, Web.

IEG 4190
Multimedia Coding and Processing
Theory of data compression. Lossless coding including Huffman code. Speech coding. Audio coding including MP3 and AC3. Image compression including JPEG. Video compression, including H.26X and MPEG. Multimedia applications. Introduction to topics in audio and image processing.

IEG 5020
Performance Evaluation Methodology
Three common performance evaluation methodologies: queueing analysis, discrete-event simulation and measurement with emphasis on queueing analysis. After a brief review including Little Law, renewal theory and PASTA, topics include: Pollaczek-Khinchine
formula, M/G/1-LCFS, M/G/1-PS, priority systems, Burke Theorem. G/M/1 systems and matrix-geometric approach. Product-form networks, including Jackson Network, Gordan Newall Network and BCMP Network, time reversible process, quasi-reversibility. Convolution algorithm, MVA. Applications to processor-based computing systems. Examples from UNIX systems. Prerequisite: IEG 4140 or its equivalent.

IEG 5030
Satellite Communications

IEG 5050
Communication Technology Seminar I
Selected topics in modern communication technologies such as cellular mobile radio systems, intelligent networks, broadband technologies, advanced coding techniques, etc., will be introduced. The topics will vary from year to year and outside experts will be invited to speak on specific topics. Each student is assigned a small problem for in-depth investigation and contribute to the final few sessions of the seminar.

IEG 5100
Communication Technology Seminar II
Selected topics in modern communication technologies such as cellular mobile radio systems, intelligent networks, broadband technologies, advanced coding techniques, etc., will be introduced. The topics will vary from year to year and outside experts will be invited to speak on specific topics. Each student is assigned a small problem for in-depth investigation and contribute to the final few sessions of the seminar. Students can take either course or both.

IEG 5110
Switching System
Crossbar switch, space division multiplexing, time division multiplexing, circuit switching v.s. packet switching, construction of non-blocking switching networks, self-route packet switching, resolution of output contention.

IEG 5120, 5130
Advanced Topics in Information Engineering I, II
These two courses will introduce to the students advanced topics in Information Engineering. The detailed course contents may be changed from year to year depending on the current development and the teacher specialty. Students can take either course or both.

IEG 5124
Signal Analysis and Applications
IEG 5140
Lightwave Networks

IEG 5150
Video Distribution on Lightwave Networks
Emerging optical technologies for new video and information distribution systems. TV signals, scanning, chrominance, luminance, modulation schemes, CATV systems, the linearity of laser diodes and optical modulator, optical amplifiers, frequency planning for distortion reduction, Digital TV principles and HDTV.

IEG 5154
Information Theory

IEG 5160
Personal Communication Systems
Evolution of wireless telecommunication systems transmission technique, network architecture, and system planning for GSM, NADC and DECT. PCS, Voice/date transmission, dynamic resource allocation, multiple access protocols and compatibility with B-ISDN.

IEG 5180
Video Compression

IEG 5190
Advanced Topics in Broadband Networks
This course will introduce to the students advanced topics in Broadband Networks. The detailed course contents may be changed from year to year depending on the current development.

IEG 5200
Advanced Topics in Computer Networks
This course will introduce to the students advanced topics in Computer Networks. The detailed course contents may be changed from year to year depending on the current development.

IEG 5210
Advanced Topics in Information Processing
This course will introduce to the students advanced topics in Information Processing. The detailed course contents may be changed from year to year depending on the current development.
IEG 5220
Advanced Topics in Multimedia Systems
This course will introduce to the students advanced topics in multimedia systems. The detailed course contents may be changed from year to year depending on the current development.

IEG 5230
Advanced Topics in Wireless Communications
This course will introduce to the students advanced topics in wireless communications. The detailed course contents may be changed from year to year depending on the current development.

IEG 5240
Cryptography, Security and E-Commerce
Symmetric cryptography. Asymmetric cryptography including integer factorization, discrete logarithm, and elliptic curve. Digital signature, one-way hashing, zero-knowledge proof, certificate and certificate authority. Secure information infrastructure, virtual private network (VPN), online shopping and payment systems, e-cash. Economic impact. Cryptography and international politics. Smart card, steganography, time stamping. Cryptanalysis technology. Pseudo-random number generator. (Not for students who have taken CSC 5470.)

IEG 7000
Computer Networks
Overview of the OSI reference model; local area network; internetworking components (switches, bridges, routers, etc.); Internet protocols; socket interface; presentation and application protocols; network administration and management; network security; network system case studies.

IEG 7001
Wireless Communication Systems
Digital and analog cellular mobile systems; physical characteristics of radio channels, cell coverage, cochannel and other interferences, channel assignment by frequency, time, or code division, handoffs, and mobility management; personal communication systems; case studies such as GSM and DECT; wireless data networks and standards; satellite communications: orbital aspects, multiple access, and applications such as GPS.

IEG 7002
Telecommunication Networks, Regulation and Practices
Concept of switching, transmission, multiplexing and concentration; circuit switch designs; packet/ATM switching principles; interconnection networks; multicast switch designs; broadband (ATM) networking; deregulation in telecommunications industry and case studies.

IEG 7003
Network Programming and System Design
Client-server system design; interprocess communication; sockets; blocking and non-blocking I/O; multi-threaded process; iterative and concurrent server designs; system-throughput bottlenecks; object-oriented programming (Java); case studies: FTP, RPC, Web.
IEG 7004
Traffic Engineering, Performance Evaluation and Quality of Service
Traffic characterization; loss systems; network blocking probabilities; delay systems, performance evaluation methodologies: queuing analysis, discrete-event simulation, concept of quality of service and measurement.

IEG 7005
Optical Communication and Lightwave Networks
Fibre, transmission modes, optical system components; lightwave systems: high speed, WDM, SCM, coherent solitons; lightwave network: LAN, WAN, MAN, DQDB, FDDI, SONET, PON, FITL, all optical networks.

IEG 7006
System Administration and Network Security
This is a 10-12 week workshop for students to gain hands-on experience in system administration and network security. Students are expected to spend at least 3 hours per week on the experiments, and each student will be assigned a Linux-based computer. The computer can be accessed via Internet so that experiments can be carried out at home. Selected topics include the set up of DNS and mail servers, the set up of certificate and secured web server for e-commerce applications, the use of network monitoring tools such as SNMP, TOP, MRTG, and tepdump, the set up of firewall, intrusion detection, and hacking techniques. Prerequisite: IEG 7000.

IEG 7007
Multimedia Coding and Processing

IEG 7008
Multimedia and Distributed Networks
Multimedia technology and trends, overview of compression techniques, multimedia storage server design, multimedia network architectures and protocols, operating system support for multimedia applications, multimedia traffic analysis, multimedia system design such as buffer design, traffic shaping, scheduling and congestion control. Advanced Internet protocols such as RSVP and RTP. Research papers on distributed multimedia and advanced Internet protocols.

IEG 7009
Advanced Topics in Information Engineering
This course will introduce to the students advanced topics in information engineering. The detailed course contents may be changed from year to year depending on the current development and the teacher specialty.

IEG 7810, 7820
Research and Development Project I, II
1/2 U
To carry out research on a topic agreed by the supervisor. A written report is required for each term. A research project which lasts for two consecutive terms. IEG 7810 and 7820 together are counted as ONE elective course. Prerequisite of IEG 7820: IEG 7810. (For second-year students.)
IEG 801T
M.Phil. Thesis Research I
To carry out research on a topic agreed by the supervisor. A written report is required for each term.

IEG 802T
M.Phil. Thesis Research II
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 801T.

IEG 803T
M.Phil. Thesis Research III
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 802T.

IEG 804T
M.Phil. Thesis Research IV
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 803T.

IEG 805T
M.Phil. Thesis Research V
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 804T.

IEG 806T
M.Phil. Thesis Research VI
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 805T.

IEG 807T
M.Phil. Thesis Research VII
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 806T.

IEG 808T
M.Phil. Thesis Research VIII
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 807T.

IEG 809T
M.Phil. Thesis Research IX
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 808T.

IEG 810T
M.Phil. Thesis Research X
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 809T.
IEG 901T
Ph.D. Thesis Research I
To carry out research on a topic agreed by the supervisor. A written report is required for each term.

IEG 902T
Ph.D. Thesis Research II
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 901T.

IEG 903T
Ph.D. Thesis Research III
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 902T.

IEG 904T
Ph.D. Thesis Research IV
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 903T.

IEG 905T
Ph.D. Thesis Research V
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 904T.

IEG 906T
Ph.D. Thesis Research VI
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 905T.

IEG 907T
Ph.D. Thesis Research VII
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 906T.

IEG 908T
Ph.D. Thesis Research VIII
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 907T.

IEG 909T
Ph.D. Thesis Research IX
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 908T.

IEG 910T
Ph.D. Thesis Research X
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 909T.
IEG 911T
Ph.D. Thesis Research XI
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 910T.

IEG 912T
Ph.D. Thesis Research XII
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 911T.

IEG 913T
Ph.D. Thesis Research XIII
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 912T.

IEG 914T
Ph.D. Thesis Research XIV
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 913T.

IEG 915T
Ph.D. Thesis Research XV
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 914T.

IEG 916T
Ph.D. Thesis Research XVI
To carry out research on a topic agreed by the supervisor. A written report is required for each term. Prerequisite: IEG 915T.

**Study Scheme**

**I. Ph.D. Programme (Full-time and Part-time)**

**A. Applicable to students admitted in 2001-02 and thereafter**

**I. Coursework Requirement**

Students are required to register and pass at least four courses from the following list with no less than two 5xxx courses. Courses outside the list may be selected on the recommendation of the thesis supervisor with the approval of the Division Head. The courses need to be taken normally within the first two terms but should not be more than three terms (or four terms for part-time students).

IEG 4020, 4030, 4060, 4100, 4130, 4140, 4160, 4180, 4190, 5020, 5030, 5050, 5100, 5110, 5120, 5124, 5130, 5140, 5150, 5154, 5160, 5180, 5190, 5200, 5210, 5220, 5230, and 5240

**2. Advancement to Doctoral Candidature**

Every Ph.D. student must submit a research proposal and pass an oral qualifying examination within two years of first registration. The examination panel should be set up according to Division guideline. Though actual presentation of research results is not expected, the general knowledge and the research potential of the student in the chosen area will be tested during
the oral examination. A supplementary oral examination will be given after three months if
the student has failed the first attempt. The student is required to withdraw from the
programme if he/she fails again in the supplementary oral examination.

The oral examination will consist of a presentation by the student and a question and answer
session. The presentation will contain a proposal of the student’s Ph.D. thesis work and
relevant background material. It is the responsibility of the supervisor to set up the oral
examination panel which in addition to the supervisor should contain two additional
Engineering faculty members. The membership of the oral examination panel should be
approved by the Division Head.

3. Other Requirements

(a) Thesis
Students are required to take IEG 9xxT before submitting a research thesis and pass an oral
examination for graduation.

<table>
<thead>
<tr>
<th>First Year of Attendance</th>
<th>Second Year of Attendance</th>
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</thead>
<tbody>
<tr>
<td>1st term: IEG 901T</td>
<td>1st term: IEG 903T</td>
</tr>
<tr>
<td>2nd term: IEG 902T</td>
<td>2nd term: IEG 904T</td>
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<td>Fourth Year of Attendance</td>
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<td>1st term: IEG 905T</td>
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<td>2nd term: IEG 908T</td>
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<tr>
<td>Fifth Year of Attendance</td>
<td>Sixth Year of Attendance</td>
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<td>1st term: IEG 909T</td>
<td>1st term: IEG 911T</td>
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<td>2nd term: IEG 910T</td>
<td>2nd term: IEG 912T</td>
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<td>Seventh Year of Attendance</td>
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<tr>
<td>2nd term: IEG 914T</td>
<td>2nd term: IEG 916T</td>
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</table>

(b) IT Proficiency Test. (Please refer to “Student IT Competence”.)

(c) An Improving Postgraduate Learning (IPL) course “Observing Intellectual Property
and Copyright Law during Research”.

B. Applicable to students admitted in 2000-01 and 1999-2000

1. Coursework Requirement

Students may be required to take special courses from the course list provided by the Division.

2. Comprehensive/Qualifying Examination

(a) All Ph.D. students must partake in the final examination of at least four of the
following graduate/final-year courses:
IEG 3010, 3310, 4020, 4030, 4100, 4130, 4140, 4160, 5020, 5110, 5124, 5154

(b) For the purpose of this qualifying examination scheme, a passing grade is equivalent
to a score not lower than the median score achieved by the undergraduate students
who partake in the same final examination. A Ph.D. student who cannot obtain
four passing grades within the first two terms of his/her study must withdraw
from the Ph.D. programme. A student who obtains only three passing grades at the
end of the second term of his/her study may request a make-up examination for a
failed course. The Division will set up an ad-hoc examination panel to administer
such a make-up examination. The list of examination courses may be revised from
time to time by the Division. If a non-final-year graduate course is chosen, the
criterion of a passing grade will be set accordingly by the Division. Students who
have taken courses in the examination list or their equivalents may apply for partial exemption subject to regulations established by the graduate panel.

3. **Other Requirements**

(a) **Thesis**

Students are required to take IEG 9xxT every term from the time of admission, throughout the preparation of thesis, until its completion.

*First Year of Attendance*  
1st term: IEG 901T  
2nd term: IEG 902T

*Second Year of Attendance*  
1st term: IEG 903T  
2nd term: IEG 904T

*Third Year of Attendance*  
1st term: IEG 905T  
2nd term: IEG 906T

*Fourth Year of Attendance*  
1st term: IEG 907T  
2nd term: IEG 908T

*Fifth Year of Attendance*  
1st term: IEG 909T  
2nd term: IEG 910T

*Sixth Year of Attendance*  
1st term: IEG 911T  
2nd term: IEG 912T

*Seventh Year of Attendance*  
1st term: IEG 913T  
2nd term: IEG 914T

*Eighth Year of Attendance*  
1st term: IEG 915T  
2nd term: IEG 916T

(b) **Oral Examination**

(i) Every Ph.D. student must submit a research proposal at the end of their first year of attendance and attend an oral examination conducted by a panel of examiners. The panel should be set up according to Division guideline. Though actual presentation of research results is not expected, the general knowledge and the research potential of the student in the chosen area will be tested during the oral examination. A supplementary oral examination will be given after three months only if the student has marginally failed the first attempt. The student is required to withdraw from the programme if he/she fails again in the supplementary oral examination.

(ii) The oral examination will consist of a presentation by the student and a question and answer session. The presentation should contain a proposal of the student’s Ph.D. thesis work and relevant background material. The normal duration of the examination is one hour. It is the responsibility of the supervisor to set up the oral examination panel which in addition to the supervisor should contain two additional Engineering faculty members. The membership of the oral examination panel should be approved by the Division Head.

(c) **IT Proficiency Test.** (For students admitted in 2000-01 and thereafter only. Please refer to “Student IT Competence”.)

II. **M.Phil. Programme (Full-time and Part-time)**

Applicable to students admitted in 2000-01 and thereafter

1. **Coursework Requirement**

Students are required to complete a minimum of 12 units of courses (coded 4xxx and 5xxx) selected from the above course list for graduation.
2. Other Requirements

(a) Students should also take IEG 8xxT every term from the time of admission, throughout the preparation of thesis, until its completion.

<table>
<thead>
<tr>
<th>First Year of Attendance</th>
<th>Second Year of Attendance</th>
</tr>
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<tbody>
<tr>
<td>1st term: IEG 801T</td>
<td>1st term: IEG 803T</td>
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<td>2nd term: IEG 802T</td>
<td>2nd term: IEG 804T</td>
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<th>Third Year of Attendance</th>
<th>Fourth Year of Attendance</th>
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<tr>
<td>1st term: IEG 805T</td>
<td>1st term: IEG 807T</td>
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<tr>
<td>2nd term: IEG 806T</td>
<td>2nd term: IEG 808T</td>
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</tbody>
</table>

(b) IT Proficiency Test. (Please refer to “Student IT Competence”.)

(c) Students are required to submit a research thesis and pass an oral examination for graduation.

(d) An Improving Postgraduate Learning (IPL) course “Observing Intellectual Property and Copyright Law during Research”. (For students admitted in 2001-02 and thereafter only.)

III. M.Sc. Programme (Part-time)

Applicable to students admitted in 2000-01 and thereafter

1. Coursework Requirement

Students are required to complete a total of 8 graduate courses, up to 2 of which could be graduate courses of other part-time programmes from Divisions within the Faculty of Engineering, subject to approval of Division concerned.

2. Other Requirements

(a) IT Proficiency Test. (Please refer to “Student IT Competence”.)

(b) An overall GPA of 2.0 or above for all graduate level courses offered by the Faculty must be achieved.

(c) Fail in no more than one course.