

*This question paper contains 4 printed pages.*

Your Roll No. ....

Sl. No. of Ques. Paper: 3141 IC  
Unique Paper Code : 22411601  
Name of Paper : Auditing and Corporate  
Governance  
Name of Course : B.Com. (Hons.)  
Semester : VI  
Duration : 3 hours  
Maximum Marks : 75

*(Write your Roll No. on the top immediately  
on receipt of this question paper.)*

*(इस प्रश्न-पत्र के मिलते ही ऊपर दिये गये निर्धारित  
स्थान पर अपना अनुक्रमांक लिखिये।)*

**NOTE:—** *Answers may be written either in English or in  
Hindi; but the same medium should be used  
throughout the paper.*

**टिप्पणी:—** *इस प्रश्नपत्र का उत्तर अंग्रेज़ी या हिन्दी किसी एक  
भाषा में दीजिए; लेकिन सभी उत्तरों का माध्यम एक ही  
होना चाहिए।*

*Attempt all questions.*

*All questions carry equal marks.*

*सभी प्रश्नों के उत्तर दीजिए।*

*सभी प्रश्नों के अंक समान हैं।*

1. (a) Explain the Rights and Duties of a Company  
Auditor.

P. T. O.

कम्पनी अंकेक्षक के अधिकार और कर्तव्य समझाइये। 8

- (b) What is statutory audit? How is it different from internal audit?

वैधानिक अंकेक्षण क्या होता है? आन्तरिक अंकेक्षण से यह किस प्रकार भिन्न है? 7

Or (अथवा)

- (a) "Detection and prevention of errors and frauds is the main objective of auditing." Comment.

"त्रुटि और धोखाधड़ी का पता लगाना और उसकी रोकथाम अंकेक्षण का मुख्य उद्देश्य है।" टिप्पणी कीजिये। 8

- (b) Differentiate between Vouching and Verification. प्रत्ययन तथा सत्यापन में अन्तर कीजिये। 7

2. (a) Define Insider Trading. Why is it considered illegal and unethical?

अंदरूनी भेदिया व्यापार को परिभाषित कीजिये। इसे क्यों गैर-कानूनी तथा अनैतिक समझा जाता है? 8

- (b) What are the provisions of Indian Companies Act, 2013 on class action?

भारतीय कम्पनी अधिनियम, 2013 के वर्गीय कार्यवाही पर क्या प्रावधान हैं? 7

Or (अथवा)

- (a) "The Enron scandal is one of the largest in the US corporate history." Explain.

"अमरीकी निगमीय इतिहास में एनरॉन कांड सबसे बड़ों में से एक है।" समझाइये। 8

- (b) Role and provisions related to Independent Directors.

स्वतन्त्र निर्देशकों से सम्बन्धित भूमिका एवं प्रावधान। 7

3. (a) What are the provisions of clause 49 on composition of BODs and audit committee?

अंकेक्षण समिति तथा BOD के संगठन पर धारा 49 के क्या प्रावधान हैं? 8

- (b) Agency theory versus Stakeholder theory.

एजेन्सी सिद्धान्त बनाम स्टैकहोल्डर सिद्धान्त। 7

Or (अथवा)

- (a) The Companies Act, 2013 makes comprehensive provisions concerning CG. Explain some of its salient features.

कम्पनी अधिनियम, 2013 ने CG से सम्बन्धित व्यापक प्रावधान बनाये हैं। इसकी कुछ मुख्य विशेषताओं को समझाइये। 8

- (b) Functions and benefits of Credit Rating Agencies.

क्रेडिट रेटिंग एजेन्सी के कार्य तथा लाभ। 7

4. Explain:

समझाइये:

- (a) Harshad Mehta Scam

(b) Carroll's Model of CSR.

(a) हर्षद मेहता काँड

(a) CSR का कैरल का मॉडल।

8,7

Or (अथवा)

(a) Cadbury Committee Report

(b) Differentiate between cost audit and management audit.

(a) कैडबरी समिति की रिपोर्ट

(b) लागत अंकेक्षण तथा प्रबन्ध अंकेक्षण में भेद कीजिये।

8,7

5. (a) Deontologists regard consequences as morally irrelevant. Do you agree? Explain.

आचारविद् निष्कर्षों को नैतिकतया अप्रासंगिक मानते हैं।

क्या आप सहमत हैं? समझाइये।

8

(b) Principles of Business Ethics.

व्यावसायिक नीतिशास्त्र के सिद्धान्त।

7

Or (अथवा)

(a) Explain the concept of Triple Bottom Line and CSR.

CSR तथा ट्रिपल बॉटम लाइन की संकल्पना को समझाइये।

8

(b) Differentiate between Ethics, Morality and Values.

नीतिशास्त्र, नैतिकता तथा मूल्यों में अन्तर्भेद कीजिये।

7

*This question paper contains 6 printed pages.*

Your Roll No. ....

**Sl. No. of Ques. Paper: 3148** **IC**  
**Unique Paper Code : 22417602**  
**Name of Paper : Consumer Affairs and  
Customer Care**  
**Name of Course : B.Com. (Hons.) : DSE-3**  
**Semester : VI**  
**Duration : 3 hours**  
**Maximum Marks : 75**

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स्थान पर अपना अनुक्रमांक लिखिये।)*

**NOTE:—** *Answers may be written either in English or in  
Hindi; but the same medium should be used  
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भाषा में दीजिए; लेकिन सभी उत्तरों का माध्यम एक ही  
होना चाहिए।*

*Attempt all questions.*

*All questions carry equal marks.*

*सभी प्रश्नों के उत्तर दीजिए।*

*सभी प्रश्नों के अंक समान हैं।*

**P. T. O.**

1. (a) Briefly describe any one ADR mechanism for out of court settlement of consumer disputes.

उपभोक्ता विवादों के न्यायालय के बाहर समझौता के लिये किसी एक ADR तंत्र का संक्षिप्त विवरण दीजिए। 8

- (b) What is Maximum Retail Price? How does a consumer gain from the provisions of MRP?

अधिकतम खुदरा मूल्य क्या है? MRP के प्रावधानों से उपभोक्ता किस प्रकार लाभांशित होता है? 7

Or (अथवा)

- (a) What is "misleading advertising"? State the major laws regulating advertising in India.

'भ्रामक विज्ञापन' क्या होता है? भारत में विज्ञापनों को नियमित करने के मुख्य कानून बताइए। 8

- (b) What is the role of BIS in consumer protection?

उपभोक्ता संरक्षण में BIS की क्या भूमिका है? 7

2. (a) Who can file a complaint under the CPA, 1986 and on what grounds can he do so?

CPA, 1986 के तहत कौन, और किन आधारों पर, शिकायत दायर कर सकता है? 8

- (b) Enumerate the six rights provided under Section 6 of the CPA.

CPA के खण्ड 6 में दिये गये छः अधिकारों को गिनाइए। 7

Or (अथवा)

Briefly explain the following terms as mentioned in the Consumer Protection Act (attempt any five):

- (a) Appeal  
(b) Defect in goods  
(c) Consumer  
(d) Limitation period  
(e) Spurious goods and services  
(f) Unfair trade practice.

CPA में उल्लेखित निम्नलिखित पदों को संक्षिप्त में समझाइए:

- (a) अपील  
(b) माल में त्रुटि  
(c) उपभोक्ता  
(d) सीमा अवधि  
(e) नकली माल व सेवाएँ  
(f) अनुचित व्यापारिक व्यवहार।

5×3=15

3. (a) What is the procedure for filing and hearing of a complaint at a consumer forum?

उपभोक्ता फोरम में शिकायत को दायर करने और सुनने की प्रक्रिया क्या है? 8

P. T. O.

(b) What action can be taken by a consumer court in following cases:

- (i) Frivolous and vexatious complaints
- (ii) Non-compliance of the order of Consumer Forum.

निम्नलिखित मुद्दों में उपरोक्त न्यायालय द्वारा क्या कार्यवाही की जा सकती है ?

- (i) वृत्त और वीथान शिकायतें
- (ii) उपरोक्त फोरम के आदेश का अनगुणन ।

(a) State the composition, powers and jurisdiction of District Forums.

जिला फोरम के संघटन, शक्तियाँ तथा सीमा क्षेत्र को बताइए ।

(b) Cite any leading case of medical negligence decided by the National Commission under the CPA.

CPA के अन्तर्गत राष्ट्रीय कमीशन द्वारा निर्णीत चिकित्सीय लापरवाही के किसी अग्रणी ब्राद का उल्लेख कीजिए ।

4. (a) What kinds of agreements are presumed to have an appreciable adverse effect on competition in India?

भारत में प्रतिस्पर्धा पर किस प्रकार के समझौते द्वारा सराहनीय प्रतिकूल प्रभाव परिकल्पित है ?

(b) Briefly list any four recent developments in the field of consumer protection in India.

भारत में उपरोक्ता संरक्षण के क्षेत्र में हाल ही के चार विकासों की सूची बताइए ।

Or (अथवा)

(a) State the conditions which indicate an abuse of dominant position by an enterprise as per the Competition Act.

प्रतिस्पर्धा अधिनियम के अन्तर्गत किसी उद्यम द्वारा अपनी प्रभावी स्थिति के दुरुपयोग का संकेत किन स्थितियों में मिलता है ?

(b) List the provisions of Competition Act relating to regulation of combinations.

समासेतनों के नियमन से सम्बन्धित प्रतिस्पर्धा अधिनियम के प्रावधानों का सूचीबद्ध कीजिए ।

5. Write short notes on any three of the following:

(a) Role of Supreme Court under CPA

(b) National Consumer Helpline

(c) Product Testing

(d) Food Safety Standards.

निम्नलिखित में से किसी तीन पर संक्षिप्त टिप्पणी कीजिए:

(a) CPA के अर्धीन सर्वोच्च न्यायालय की भूमिका

3148

6

- (b) राष्ट्रीय उपभोक्ता हेल्पलाइन
- (c) उत्पाद परीक्षण
- (d) खाद्य सुरक्षा मानक।

5×3=15

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*This question paper contains 10 printed pages.*

Your Roll No. ....

**Sl. No. of Ques. Paper: 3147**

**IC**

**Unique Paper Code : 22417601**

**Name of Paper : Fundamentals of Investment**

**Name of Course : B.Com. (Hons.) : DSE - 3**

**Semester : VI**

**Duration : 3 hours**

**Maximum Marks : 75**

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स्थान पर अपना अनुक्रमांक लिखिये।)*

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भाषा में दीजिए; लेकिन सभी उत्तरों का माध्यम एक ही  
होना चाहिए।*

*Attempt all questions.*

*Use of simple calculator is allowed.*

*सभी प्रश्नों के उत्तर दीजिए।  
साधारण कैल्कुलेटर के उपयोग की अनुमति है।*

1. (a) What do you mean by investor's education? What are the rights and responsibilities of an investor?

P. T. O.



निवेशक की शिक्षा से आपका क्या तात्पर्य है? एक निवेशक के क्या अधिकार एवं उत्तरदायित्व हैं? 4

- (b) An investor wants to invest in one of the two securities with equal returns but different probabilities. Compute the expected return and risk of both the securities. Which security should the investor buy?

Return (%)	Probability (X)	Probability (Y)
-5	0.2	0.1
10	0.3	0.1
12	0.2	0.3
15	0.2	0.2
18	0.1	0.3

एक निवेशक समान प्रतिफल परन्तु भिन्न प्रायिकता वाली दो प्रतिभूतियों में से एक में निवेश करना चाहता है। दोनों प्रतिभूतियों के जोखिम एवं अनुमानित प्रतिफल की गणना कीजिए। कौनसी प्रतिभूति को निवेशक द्वारा खरीदा जाना चाहिए? 11

वापसी (%)	प्रायिकता (X)	प्रायिकता (Y)
-5	0.2	0.1
10	0.3	0.1
12	0.2	0.3
15	0.2	0.2
18	0.1	0.3

Or (अथवा)

- (a) What is SEBI? What are its objectives?

SEBI क्या है? इसके उद्देश्य क्या हैं? 4

- (b) An investor purchases an equity share at a price of Rs. 50. Its expected year end price and dividend with relevant probabilities are given below:

Probability	Share Price (Rs.)	Dividend (Rs.)
0.20	70	6
0.15	65	5
0.25	55	4
0.15	50	3
0.25	42	NIL

Find out the expected return and variability of return of the equity share.

एक निवेशक 50 रु० की कीमत पर एक समता अंश खरीदता है। वर्ष की समाप्ति पर इसकी अनुमानित कीमत तथा लाभांश से सम्बन्धित प्रायिकताएँ नीचे दी गई हैं:

प्रायिकता	अंश कीमत (रु०)	लाभांश (रु०)
0.20	70	6
0.15	65	5
0.25	55	4
0.15	50	3
0.25	42	NIL

समता अंश के अनुमानित प्रतिफल तथा प्रतिफल की परिवर्तनशीलता की गणना कीजिए। 11

2. (a) What is primary market? How is it different from secondary market?

P. T. O.

प्राथमिक बाजार क्या है? यह द्वितीयक बाजार से कैसे भिन्न है? 4

- (b) Mr. X is considering to buy a bond having face value of Rs. 2000 which will be redeemed over a period of 5 years in five equal annual instalments. The bond carries a coupon rate of interest of 8%. Find the value at which Mr. X would like to buy the bond if his expected rate of return is 10%.

मि० X 2000 रु० अंकित मूल्य के एक बॉण्ड को खरीदने की सोच रहा है जिसका पाँच वर्ष की अवधि में पाँच समान किस्तों में मोचन होगा। बॉण्ड की कूपन ब्याज दर 8% है। मूल्य ज्ञात कीजिए जिस पर मि० X को बॉण्ड खरीदना चाहिए यदि उसकी अपेक्षा 10% वापसी की दर की है। 11

Or (अथवा)

- (a) Explain the term investment. What factors should an investor consider while making investment decision?

निवेश पद को समझाइए। निवेश निर्णय लेते समय एक निवेशक को क्या कारक ध्यान में रखने चाहिए? 4

- (b) A 12 % bond of Rs. 100 is available in the market at Rs. 95. The interest is payable semi-annually. The bond will mature in 5 years from now. Compute yield to maturity (YTM) of this bond. What will be the value of the bond if the required rate of return of an investor is 14%? Should he buy the bond?

12% का बॉण्ड 100 रु० बाजार में 95 रु० में सुलभ है। ब्याज अर्ध-वार्षिक देय है। बॉण्ड आज से पाँच वर्ष बाद परिपक्व होगा। इस बॉण्ड की परिपक्वता की प्राप्ति (YTM) की गणना कीजिए। यदि एक निवेशक की प्रतिफल की अपेक्षित दर 14% है तो बॉण्ड की कीमत क्या होगी? क्या उसे बॉण्ड खरीदना चाहिए? 11

3. (a) Differentiate between Bar Chart and Candle Stick Chart.

बार चार्ट और केन्डिल स्टिक चार्ट में अन्तर्भेद कीजिए। 4

- (b) ABC Company is expected to grow at 10% per year for the next 4 years and then to grow indefinitely at rate of 7% p.a. The required rate of return on the equity shares is 12%. The company paid a dividend of Rs. 2 per share last year. Determine the market price of the share today.

ABC कम्पनी की अगले चार वर्षों में प्रतिवर्ष 10% वृद्धि अनुमानित है और फिर 7% की दर की वृद्धि अनिश्चित काल तक अनुमानित है। समता अंशों पर प्रतिफल की अपेक्षित दर 12% है। कम्पनी ने पिछले वर्ष 2 रु० प्रति अंश लाभांश का भुगतान किया। अंश की वर्तमान बाजार कीमत का निर्धारण कीजिए। 11

Or (अथवा)

P. T. O.

- (a) What is Market Efficiency? What are its three forms?

बाजार दक्षता क्या है? इसके तीन प्रारूप क्या हैं? 4

- (b) A company's share is currently selling at Rs. 144. The dividend paid by the company last year was Rs. 9.60 per share. If the expected rate of growth of dividend is  $g$  and the required rate of return ( $k_e$ ) is 12, what will be the share price after 2 years?

एक कम्पनी का अंश 144 रु० में बिक रहा है। कम्पनी ने पिछले वर्ष प्रति अंश 9.60 रु० लाभांश का भुगतान किया था। यदि लाभांश की अनुमानित वृद्धि की दर  $g$  है और प्रतिफल की आवश्यक दर ( $k_e$ ) 12% है, तो 2 वर्ष पश्चात् अंश की कीमत क्या होगी? 11

4. (a) What do you mean by credit rating? Explain its importance in investment decision.

क्रेडिट रेटिंग से आपका क्या तात्पर्य है? निवेश-निर्णय में इसकी महत्ता को समझाइए। 4

- (b) The following are the expected returns and risk of securities A and B:

	Expected Returns	Standard Deviation
A	12%	16%
B	15%	20%

The correlation coefficient between the returns of A and B is 0.8. An investor wants to put 40% of

his investment in A and 60% in B or 40% in B and remaining 60% in A. Which portfolio is better?

प्रतिभूतियाँ A व B के जोखिम और अनुमानित प्रतिफल निम्न हैं:

	अनुमानित वापसी	प्रमाप विचलन
A	12%	16%
B	15%	20%

A तथा B के प्रतिफलों के बीच सहसम्बन्ध गुणांक 0.8 है। एक निवेशक A में 40% तथा B में 60% अथवा 40% B में तथा 60% A में निवेश करना चाहता है। कौन सा पोर्टफोलियो श्रेष्ठ है? 11

Or (अथवा)

- (a) What is a deep discount bond? How is the value of such bond calculated?

डीप डिस्काउंट बॉण्ड क्या है? ऐसे बॉण्ड के मूल्य की कैसे गणना की जाती है? 4

- (b) From the data given below, find which of the following securities are over-priced or under-priced using SML equation:

Security	A	B	C	D	E
$\beta$	1.6	0.5	1.2	3.0	1.9
Return	15	10	18	25	15

The return on market index is 12% and the return on risk free asset is 8%.

नीचे दिये गये आंकड़ों से, SML समीकरण का उपयोग

करके, ज्ञात कीजिए कि कौन सी प्रतिभूति का मूल्य अधिक  
है तथा किसका मूल्य कम है।

प्रतिभूति	A	B	C	D	E
$\beta$	1.6	0.5	1.2	3.0	1.9
वापसी	15	10	18	25	15

बाजार सूची पर प्रतिफल 12% है और जोखिम मुक्त  
सम्पत्ति पर प्रतिफल 8% है।

11

5. (a) The following particulars are given relating to a  
mutual fund:—

Opening NAV	Rs. 104 crores
Closing NAV	Rs. 162 crores
Administrative expenses including	
Fund Manager remuneration	Rs. 253 lakhs
Management Advisory Fees	Rs. 132 lakhs
Publicity and Documentation	Rs. 70 lakhs

Ascertain the Expense Ratio.

एक म्यूचुअल फंड से सम्बन्धित विवरण नीचे दिये गये हैं:

प्रारम्भिक NAV	रु० 104 करोड़
अन्तिम NAV	रु० 162 करोड़
फंड प्रबन्धक के पारिश्रमिक सहित	
प्रशासनिक व्यय	रु० 253 लाख
प्रबन्धन सलाह शुल्क	रु० 132 लाख
जनसंचार व प्रलेखन	रु० 70 लाख

व्यय अनुपात का पता लगाइए।

4

(b) Mr. X is holding shares of A Ltd. in his portfolio.  
Probability distribution of expected return from  
this stock and market index is given below:

Situation	Probability	Return of A %	Return of Market (%)
Recession	0.2	10	10
Average	0.4	12	16
Good	0.3	21	22
Boom	0.1	27	29

The risk free rate is 6%. Assume that CAPM  
conditions hold true. Should Mr. X continue to  
hold this stock in his portfolio?

मि० X ने अपने पोर्टफोलियो में A लि० के अंश रखे हैं।  
इस स्टॉक से अनुमानित प्रतिफल का प्रायिकता वितरण  
और बाजार सूचीयन नीचे दिया गया है:

स्थिति	प्रायिकता	A की वापसी (%)	बाजार की वापसी (%)
मंदी	0.2	10	10
औसत	0.4	12	16
अच्छा	0.3	21	22
खराब	0.1	27	29

जोखिम मुक्त दर 6% है। मानते हुए कि CAPM  
स्थितियाँ सत्य हैं, क्या मि० X को अपने पोर्टफोलियो में  
इस स्टॉक को रखे रखना चाहिए?

11

Or (अथवा)

P. T. O.

- (a) What do you mean by Systematic Investment Plan? What are its benefits?

पद्धतिबद्ध निवेश योजना से आपका क्या अर्थ है? इसके क्या लाभ हैं? 4

- (b) Mr. A has bought call and put options both. Each contract is of 100 shares. He has purchased one 3-months call with a strike price of Re. 54 and Rs. 2 as premium. He has purchased a 3-months put option with a strike price of Rs. 50 and Rs. 1 as premium. Find out his position and total profit or loss if stock price on expiration date is: (i) Rs. 48, (ii) Rs. 58.

मि० A ने कॉल एवं पुट विकल्प दोनों को खरीदा है। प्रत्येक अनुबन्ध 100 अंशों का है। उन्होंने 54 रु० के स्ट्राइक मूल्य और 2 रु० प्रीमियम के साथ एक तीन माह की कॉल खरीदी है। उन्होंने 50 रु० के स्ट्राइक मूल्य और 1 रु० प्रीमियम के साथ तीन माह का एक पुट विकल्प खरीदा है। उनका कुल लाभ या हानि तथा स्थिति ज्ञात कीजिए यदि समयसीमा समाप्ति की तारीख पर स्टॉक की कीमत (i) 48 रु०, (ii) 58 रु०, हो 4

[This question paper contains 24 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : 3142 IC

Unique Paper Code : 22411602

Name of the Course : B.Com. (Hons.)

Name of the Paper : Goods & Service Tax  
(GST) & Custom Law

Semester : VI

**Time : 3 Hours** **Maximum Marks : 75**

**Instructions for Candidates :**

परीक्षार्थियों के लिए निर्देश :

- (a) Write your Roll No. on the top immediately on receipt of this question paper.

इस प्रश्न-पत्र के प्राप्त होने पर तुरंत शीर्ष पर अपना रोल नंबर लिखें।

- (b) Answer may be written either in **English** or in **Hindi**; but the same medium should be used throughout the paper.

इस प्रश्न-पत्र का उत्तर अंग्रेजी या हिंदी किसी एक भाषा में दीजिए, लेकिन सभी उत्तर एक ही भाषा में होने चाहिए।

P.T.O.

(c) Attempt all questions.

सभी प्रश्नों को करिये ।

(d) Questions from each part must be attempted.

प्रत्येक भाग के प्रश्न अनिवार्य हैं।

1. (a) Write briefly about GST network & functions of GSTN portal. 5

जीएसटी नेटवर्क और जीएसटीएन पोर्टल के कार्यों के बारे में संक्षेप में लिखें।

(b) What is the meaning of term Registration under GST ? State the Persons who are exempted from Registration under GST Act. 5

जीएसटी के तहत शब्द पंजीकरण का क्या अर्थ है ? उन व्यक्तियों को बताएँ जिन्हें जीएसटी अधिनियम के तहत पंजीकरण से छूट प्राप्त है।

(c) XYZ Ltd. Pune makes the following supplies during the year 2018 : 5

एक्स वाई जेड लि० पुणे वर्ष 2018 के दौरान निम्नलिखित आपूर्ति करता है :

S. No.	Particulars	Amount (₹)
क्र० सं०	विवरण	रकम (₹)
1	Supply of Taxable Goods कर योग्य माल की आपूर्ति	5,00,000
2	Supply of Exempt Goods छूट वाले माल की आपूर्ति	2,00,000
3	Inter- State Supply of goods माल की अंतरराज्यीय आपूर्ति	3,00,000
4	Export of Goods माल का निर्यात	5,00,000
5	Outward supply under reverse charge उल्टे मूल्य के तहत बाहरी (जावक) आपूर्ति	4,00,000
6	Inward supply under reverse charge उल्टे मूल्य के तहत आंतरिक (आवक) आपूर्ति	5,00,000

(i) Calculate the aggregate turnover for the year 2018.

वर्ष 2018 के लिए कुल कारोबार की गणना करें।

(ii) Is the company liable to register under section 22 of GST Act, 2017? Answer With reason.

क्या कंपनी जीएसटी अधिनियम, 2017 की धारा 22 के तहत पंजीकरण करने के लिए उत्तरदायी है ? कारण सहित उत्तर दें।

(iii) Will it make a difference to the registration requirement if company is in State of Jammu & Kashmir ?

अगर कंपनी जम्मू और कश्मीर राज्य में है तो क्या इससे पंजीकरण की आवश्यकता पर फर्क पड़ेगा ?

(iv) Is company otherwise liable to register and why ?

क्या कंपनी पंजीकरण के लिए उत्तरदायी है और क्यों ?

OR

अथवा

(a) Write a note on State Compensation Mechanism provided under GST Laws to compensate the States for loss of revenue. 5

राज्यों को राजस्व के नुकसान की भरपाई के लिए जीएसटी कानून के तहत दिए गए राज्य क्षतिपूर्ति तंत्र पर एक नोट लिखें।

(b) Explain the provisions of registration relating to Casual Taxable Person and Non-Residential taxable person. 5

आकस्मिक कर योग्य व्यक्ति और गैर-आवासीय कर योग्य व्यक्ति से संबंधित पंजीकरण के प्रावधानों की व्याख्या करें।

(c) Decide giving reason whether registration under GST is required or not in following cases : 5

निम्नलिखित मामलों में जीएसटी के तहत पंजीकरण आवश्यक है या नहीं, इसका कारण तय करें :



(i) Mr. P, a qualified Chartered Accountant based in Manipur is employed as Audit Head of ABC Firm, drawing a salary of ₹ 50,000 per month. He owns a residential property which is let out for residential purposes at a monthly rent of ₹ 1,50,000. He also gives part time tax consultancy and earns ₹ 5,00,000 per annum.

मणिपुर में स्थित एक योग्य चार्टर्ड एकाउंटेंट श्री पी, ए बी सी, फर्म के लेखा प्रमुख के रूप में कार्यरत है, जो प्रतिमाह 50,000 ₹ का वेतन आहरण करते हैं। वह एक आवासीय संपत्ति का मालिक है जिसे 1,50,000 ₹ के मासिक किराए पर आवासीय प्रयोजनों के लिए बाहर रखा गया है। वह अंशकालिक कर परामर्श भी देता है और प्रतिवर्ष 5,00,000 ₹ कमाता है।

(ii) Mr. X is a retired person earning pension of ₹ 4,20,000 per annum. He owns two buses engaged in providing transportation services to local school for students for which he charges 2,00,000 annually per bus. He has fixed deposits in banks earning annual interest of ₹ 10,60,000.

मि० एक्स सेवानिवृत्त व्यक्ति हैं जो प्रति वर्ष 4,20,000 ₹ की पेंशन कमा रहे हैं। उनके पास संकाय, कर्मचारियों और छात्रों के वायोट्रान्सपोर्ट के लिए स्थानीय स्कूल में परिवहन सेवाएँ प्रदान करने के लिए दो बसें हैं जिसके लिए वह प्रति बस 2,00,000 वार्षिक शुल्क लेते हैं। उन्होंने बैंकों में 10,60,000 ₹ वार्षिक आय अर्जित करने वाले सावधि जमाओं को निर्धारित किया है।

2. (a) Explain the activities which are treated as supply even if made without consideration. 5

बिना सोचे समझे किए गए कार्यों को आपूर्ति के रूप में समझाएँ।

(b) Give a list of Ten items of goods which are exempt from tax. Also state provisions relating to education services which are exempt from tax. 5

उन दस वस्तुओं की सूची दें जिन्हें कर से छूट दी गई है, शिक्षा सेवाओं से संबन्धित राज्य प्रावधान भी हैं जिन्हें कर से छूट प्राप्त है।

(c) ABC Limited manufacturers 3000 units of product having assessable value @ ₹500 per piece. ABC Limited sold 1600 pieces in Domestic Tariff Area (DTA) and balance 1400 pieces were exported. If the rate of SGST & CGST payable is 9% each. Calculate GST on outward supplies of the following : 5

ए बी सी लि० निर्माताओं के उत्पाद के 3000 इकाईयों का मूल्यांकन मूल्य @ ₹ 500 प्रति पीस है। ए बी सी लि० ने घरेलू टैरिफ क्षेत्र (डी टी ए) में 1600 टुकड़े बेचे और शेष 1400 टुकड़े निर्यात किए गए। अगर एसजीएसटी (SGST) और सीजीएसटी (CGST) की देय दर 9% है। निम्नलिखित की बाहरी आपूर्ति पर जीएसटी की गणना करें :

- (i) Supply of 1600 pieces in DTA  
डी टी ए में 1600 टुकड़ों की आपूर्ति
- (ii) Export of 1400 pieces  
1400 टुकड़ों का निर्यात

OR

अथवा

2. (a) How the location of recipient and supplier of services is defined for the purpose of determining place of supply in case of domestic transactions ? Also state the general provisions for place of supply of services : 5

घरेलू लेनदेन के मामले में आपूर्ति के स्थान का निर्धारण करने के उद्देश्य से सेवाओं के प्राप्तकर्ता और आपूर्तिकर्ता के स्थान को कैसे परिभाषित किया जाता है ? सेवाओं की आपूर्ति के स्थान के लिए सामान्य प्रावधानों को भी बताएं।

- (i) When the recipient is registered person.  
जब प्राप्तकर्ता पंजीकृत व्यक्ति है।
- (ii) When the recipient is unregistered person.  
जब प्राप्तकर्ता अपंजीकृत व्यक्ति है।

2. (b) Mr. Arun, of Chennai, a registered taxpayer, making intra - state supply during 2018, reported following transactions : 5  
चेन्नई के मि० अरुण ने एक पंजीकृत करदाता, 2018 के दौरान अंतर-राज्य सप्लाई की लेन-देन के बाद सूचित किया :

S. No.	Particulars	Value of Supply	Rate of GST
क्रमांक	विवरण	आपूर्ति का मूल्य	जीएसटी की दर
1	Supply of manufactured goods निर्मित वस्तुओं की आपूर्ति	18,00,000	12%
2	Supply of traded goods व्यापार के सामान की आपूर्ति	22,00,000	12%
3	Supply of manufactured goods निर्मित माल की आपूर्ति	25,00,000	NIL
4	Supply of traded goods व्यापार के सामान की आपूर्ति	10,00,000	NIL

Explain with reason the eligibility of Mr. Arun to opt for composition scheme. Also calculate his tax liability if he opts for composition scheme.

रचना योजना का चयन के लिए मि० अरुण की योग्यता का कारण बताएं। यदि वह रचना योजना का विरोध करता है तो उसकी कर देयता की भी गणना करें।

2. (c) Mr. X, a registered person supplied goods to Mr. Y, also a registered person. From the following details determine the time of supply:

मि० एक्स एक पंजीकृत व्यक्ति है और मि० वाई को एक पंजीकृत व्यक्ति को माल की आपूर्ति की जाती है। निम्नलिखित विवरण से आपूर्ति का समय निर्धारित होता है।

S. No.	Particulars	Rate of GST
क्रमांक	विवरण	जीएसटी की दर
1	Date of removal of goods माल निकालने की तिथि	18-11-2018
2	Date of issue of invoice चालान जारी करने की तारीख	28-11-2018

3142

3 Date of payment entered 30-11-2018  
in the books of account of X

एक्स के खाते की पुस्तकों में  
भुगतान की तारीख दर्ज की गई

4 Date on which amount is 01-12-2018  
created in the banks account  
of X

एक्स के बैंकों के खाते में किस  
राशि का सृजन होता है।

Determine the time of supply of goods .  
माल आपूर्ति का तिथि निर्धारण करें।

3. (a) What is Reverse Charge Mechanism?  
Mention notified goods where GST is payable  
by the recipient of goods. 5

उल्टा मूल्य यंत्र क्या है ? अधिसूचित सामानों का  
उल्लेख किया गया है, जहाँ माल प्राप्त करने वाले  
द्वारा जीएसटी देय है।

(b) ABC Ltd., a registered supplier is engaged  
in the manufacture of taxable goods. The  
company provides the following information  
of GST paid on the input goods/services  
during the month of September 2018 : 5

12

3142

ए बी सी लि० पंजीकृत आपूर्ति कर योग्य वस्तुओं के  
निर्माण में लगी हुई है। कंपनी सितंबर 2018 के  
महीने के दौरान इनपुट सामान/ सेवा पर दिए गए  
जीएसटी की निम्नलिखित जानकारी प्रदान करती है :

Particulars	GST paid (₹)
विवरण	जीएसटी भुगतान किया (₹)
I. Purchases of motor vehicles for transportation of inputs इनपुट के परिवहन के लिए मोटर वाहनों की खरीद	3,30,000
II. Inputs consisting of three lots, out of which first lot was received during the month निवेश तीन भाग से मिलकर, जिसमें से पहला भाग महीने के दौरान प्राप्त हुआ था	1,25,000

13

P.T.O.

3142

III.	Capital goods (out of three invoices , one was missing and GST paid on that invoice was ₹ 25,000) पूँजीगत वस्तुएँ (तीन चालान में से, एक लापता था और उस चालान पर जीएसटी का भुगतान 25,000 ₹ था )	2,50,000
IV.	Outdoor catering services availed on Women's day (for the women employees) महिला दिवस पर (महिला कर्मचारियों के लिए) बाहरी खानपान सेवाएं	72,000
V.	Corporate membership of a club to be used by the directors to entertain foreign collaborators विदेशी सहयोगियों के मनोरंजन के लिए निदेशकों द्वारा उपयोग की जाने वाली एक क्लब की कॉर्पोरेट सदस्यता	50,000
<b>Total</b>		<b>8,27,000</b>
कुल		

3142

Determine the amount of Input tax credit available to ABC Ltd. for the month of September, 2018 by giving necessary explanations for the treatment of various transactions.

विभिन्न लेन-देन के निरूपण के लिए आवश्यक स्पष्टीकरण देकर सितंबर, 2018 के महीने के लिए एबीसी लि० को उपलब्ध निवेश टैक्स क्रेडिट की मात्रा निर्धारित करें।

(c) X Ltd. sends some semi finished goods for further processing to Y Ltd. (job worker) on 18<sup>th</sup> September, 2017 and machinery to Z Ltd. (job worker) for fixing some technical issues on 19, September, 2017. Discuss the provisions related to tax liability under GST in if X ltd. Receives back :

एक्स लि० 18 सितंबर, 2017 को वाई लि० (जॉब वर्कर) को आगे की प्रक्रिया के लिए कुछ अर्ध तैयार माल भेजती है और 19 सितंबर, 2017 को कुछ तकनीकी मुद्दे को ठीक करने के लिए जेड लि० (जॉब वर्कर) को मशीनरी / कर देयता से संबंधित प्रावधानों पर चर्चा करें यदि एक्स लि० वापस प्राप्त करता है :

(i) Finished goods from Y ltd. on

वाई लि० से माल तैयार किया

Case I - 28 December, 2018

केस I - 28 दिसम्बर, 2018

Case II-15<sup>th</sup> -January, 2018

केस II-15 जनवरी, 2018

(ii) Machinery from Z ltd on

जेड लि से मशीनरी

Case I- 28 December, 2018

केस I - 28 दिसम्बर, 2018

Case II- 24 September, 2020

केस II-24 सितंबर, 2020

OR

अथवा

3. (a) What do you mean by Input Tax Credit ? What are the conditions for availing Input Tax Credit ?

5

इनपुट टैक्स क्रेडिट का क्या मतलब है ? निवेश कर श्रेय का लाभ उठाने के लिए क्या शर्तें हैं ?

3. (b) What are the provisions regarding claim of ITC on Capital goods and inputs lying in stock and contained in semi-finished and finished goods when a person becomes liable for registration under GST ?

5

जब कोई व्यक्ति जीएसटी के तहत पंजीकरण के लिए उत्तरदायी हो जाता है, तो पूंजीगत वस्तुओं और स्टॉक में पड़े निवेश और अर्ध-तैयार औ तैयार माल में निहित आईटीसी के दावे के बारे में क्या प्रगावधान है ?

3. (c) Aruna Limited , a registered person, based in Lucknow is into manufacturing of Product 'A' ( exempted goods) and Product 'B' (taxable goods). Both the products are produced with the same raw material. Aruna Limited purchased raw material of ₹ 6,00,000 from Lucknow and paid CGST @9% and SGST @9%, which makes ₹ 54,000 as CGST and ₹ 54,000 as SGST .The total turnover of Aruna Limited is ₹ 12,00,000 out of which ₹ 4,00,000 is turnover of Product 'A' (exempted supplies) and ₹ 8,00,000 is turnover of Product 'B' (taxable supplies). Calculate the amount of Input Tax Credit to be reversed.

5

लखनऊ में स्थित अरूणा लि० एक पंजीकृत व्यक्ति, उत्पाद 'ए' (छूट वाले माल) और उत्पादों 'बी' (कर योग्य वस्तुओं) के निर्माण में है। दोनों उत्पाद एक ही कच्चे माल के साथ उत्पादित किए जाते हैं। अरूणा लि० ने लखनऊ से 6,00,000 ₹ की कच्ची सामग्री खरीदी और 9% पर सीजीएसटी और 9% पर एसजीएसटी का भुगतान, किया जो 54,000 ₹ सीजीएसटी और 54,000 ₹ एसजीएसटी के रूप में मिलता है। अरूणा लि० का कुल कारोबार 12,00,000 ₹ है जिसमें से 4,00,000 ₹ उत्पाद 'अ' (छूट वाली आपूर्ति) का कारोबार है और 8,00,000 ₹ उत्पाद 'ब' (कर योग्य आपूर्ति) का कारोबार है। उल्टा होने के लिए निवेश कर मूल्य की मात्रा की गणना करें।

4. (a) What is the time limit for issuance of Tax invoice in the following cases : 5

निम्नलिखित मामलों में कर चालान के प्रचालन की समय सीमा क्या है :

(i) Supply of Taxable Goods

कर योग्य वस्तुओं की आपूर्ति

(ii) Supply of Taxable Services

कर योग्य सेवाओं की आपूर्ति

(iii) Continuous Supply of Goods

माल की निरंतर आपूर्ति

(b) Under what circumstances provisional assessment is conducted under GST ? Discuss the provisions related to tax & interest liability of the Taxpayer on finalization of provisional assessment 5

जीएसटी के तहत किन परिस्थितियों में अंतिम मूल्यांकन किया जाता है। अन्तरिम मूल्यांकन को अंतिम रूप देने पर करदाता के कर और ब्याज देयता से संबंधित प्रावधानों पर चर्चा करें।

(c) Distinguish between cognizable offences & non- cognizable offences under GST ? 5

जीएसटी के तहत संज्ञेय अपराधों और गैर संज्ञेय अपराधों के बीच अंतर कीजिए।

OR

अथवा

4. (a) Discuss the provisions related to form, due date and persons liable to furnish details of outward supply under section 37 of CGST Act, 2017. What is the late fee payable in case of delay in furnishing details of outward supplies ? 5

सीजीएसटी अधिनियम, 2017 की धारा 37 के तहत बाहरी आपूर्ति के विवरण प्रस्तुत करने के लिए फार्म, नियत तारीख और व्यक्ति से संबंधित प्रावधानों पर चर्चा करें।

(b) Write briefly about the Special Audit required under GST. 5

जीएसटी के तहत आवश्यक विशेष ऑडिट के बारे में संक्षेप में लिखें।

(c) Write a short note on E-way bills under GST. 5

जीएसटी के तहत ई-वे बिल पर एक संक्षिप्त नोट लिखें।

5. (a) Explain the provisions related to determination of Taxable event in case of Imports & Exports under Indian Custom Laws. 5

भारतीय रिवाज कानूनों के तहत आयात और निर्यात के मामले में कर योग्य घटना के निर्धारण से संबंधित प्रावधानों की व्याख्या करें।

(b) Write a note on Anti Dumping Duty and Margin of Dumping. 5

एंटी डंपिंग ड्यूटी और डंपिंग के मार्जिन पर एक नोट लिखें।

(c) Determine the taxable value of supply in the following cases : 5

निम्नलिखित मामलों में आपूर्ति के कर योग्य मूल्य का निर्धारण करें :

(i) The US \$4000 are converted into UK £3000. The RBI reference rate at that time for US \$ is ₹ 70 per dollar and UK £ is ₹ 95 per UK Pound.

यूएस \$4000 को यूके £3000 आरबीआई संदर्भ दर में परिवर्तित किया जाता है। उस समय यूएस ₹ 70 प्रति डालर है और यूके ₹ 95 प्रति यूके पाउंड है।

(ii) Mr. Vikas, an air travel agent provided the following details for the Month of January, 2019 :

मि० विकास ने एक हवाई यात्रा एजेंट को जनवरी, 2019 के महीने के लिए निम्नलिखित विवरण प्रदान किए :



Particulars विवरण	Amount (₹) रकम (₹)
Basic fare collected for booking tickets for travel within India भारत के भीतर यात्रा के लिए टिकट बुक करने के लिए मूल किराया एकत्र किया गया	6,80,000
Basic fare collected for booking tickets for travel outside India भारत के बाहर यात्रा के लिए टिकट बुकिंग के लिए मूल किराया एकत्र किया गया	8,50,000

OR

अथवा

5. (a) What is the meaning of transaction value under GST? What elements included in the transaction value? State the provisions related to treatment of discount for the purpose of calculating the transaction value.

5

जीएसटी के तहत लेन-देन मूल्य का क्या अर्थ है ?  
लेन-देन मूल्य में कौन से तत्व शामिल है ? लेन-देन  
मूल्य की गणना के उद्देश्य से छूट के उपचार से  
संबंधित प्रावधानों को बताएँ।

- (b) A Ltd., India imported material from XYZ Ltd. of Germany. The FOB price is ₹ 21,00,000. The cost of transportation is ₹ 5,45,000. Unloading and handling charges at Indian port are ₹ 1,90,000. 10

एक सीमित भारत जर्मनी के एक्स वाई जेड लि० से  
आयातित सामग्री है। एफ ओ बी मूल्य ₹ 21,00,000  
है। परिवहन की लागत ₹ 5,45,000 है। भारतीय पोर्ट  
पर लोडिंग और हैडलिंग चार्ज ₹ 1,90,000 है।

- (i) Calculate the assessable value (CIF) if goods are imported by air and insurance cost is not ascertainable.

मूल्यांकन योग्य मूल्य (सी आईव एफ) की गणना  
करे यदि सामान बालु द्वारा आयात किया जाता  
है और बीमा लागत लगाने योग्य नहीं है।

3142

(ii) Calculate the assessable value (CIF) if the goods are imported by sea and insurance cost is ₹ 75,000.

मूल्यांकन योग्य मूल्य (सीआई एफ) की गणना करें यदि माल समुद्र द्वारा आयात किया जाता है और बीमा लागत ₹ 75,000 है।

24

8,400

*This question paper contains 4 printed pages.*

Your Roll No. ....

*Sl. No. of Ques. Paper: 3152* **IC**  
*Unique Paper Code : 22417604*  
*Name of Paper : International Business*  
*Name of Course : B.Com. (Hons.) : DSE-4*  
*Semester : VI*  
*Duration : 3 hours*  
*Maximum Marks : 75*

*(Write your Roll No. on the top immediately  
on receipt of this question paper.)*

*(इस प्रश्न-पत्र के मिलते ही ऊपर दिये गये निर्धारित  
स्थान पर अपना अनुक्रमांक लिखिये।)*

**NOTE:—** *Answers may be written either in English or in  
Hindi; but the same medium should be used  
throughout the paper.*

**टिप्पणी:—** *इस प्रश्नपत्र का उत्तर अंग्रेजी या हिन्दी किसी एक  
भाषा में दीजिए; लेकिन सभी उत्तरों का माध्यम एक ही  
होना चाहिए।*

*Attempt all questions. Answer all parts together.  
All questions carry equal marks.*

*सभी पाँच प्रश्नों के उत्तर दीजिए। सभी भागों का उत्तर एक साथ  
दीजिये। सभी प्रश्नों के अंक समान हैं।*

1. (a) List and explain the different modes of entry for  
an international business firm.

*Turn over*

एक अन्तर्राष्ट्रीय व्यापारिक फर्म के प्रवेश के विभिन्न तरीकों की सूची बनाइये और समझाइये। 7

- (b) What is international business? Briefly explain the factors that have led to growth of international business in recent years.

अन्तर्राष्ट्रीय व्यापार क्या है? अन्तर्राष्ट्रीय व्यापार में हाल के वर्षों में हुई वृद्धि के कारकों को संक्षिप्त में समझाइये। 8

Or (अथवा)

Explain the salient features of the complex, multi-dimensional and interrelated business environment in which the multinational corporation has to operate.

उस जटिल, बहुआयामी और परस्पर-सम्बन्धित व्यापारिक वातावरण की मुख्य विशेषताओं को समझाइये जिसमें बहुराष्ट्रीय निगमों को कार्य करना पड़ता है। 15

2. (a) Explain the role of the WTO as a regulator of world trade.

विश्व व्यापार के नियामक के रूप में WTO की भूमिका समझाइये। 7

- (b) "Balance of payments always balances." Elucidate. But how do you explain disequilibrium in balance of payment?

"भुगतान संतुलन हमेशा संतुलित हो जाता है।" स्पष्ट कीजिये। परन्तु आप भुगतान सन्तुलन में असन्तुलन को किस प्रकार समझायेंगे? 8

Or (अथवा)

Explain Porter's theory of national competitive advantage as a theory of international trade.

अन्तर्राष्ट्रीय व्यापार के सिद्धान्त के रूप में राष्ट्रीय प्रतिस्पर्धात्मक लाभ के पोर्टर के सिद्धान्त को समझाइये। 15

3. What are the measures taken by the Government of India to promote FDI in India?

भारत में FDI के संवर्द्धन के लिये भारतीय सरकार ने क्या कदम उठाये हैं? 15

Or (अथवा)

Write short notes on any two:—

- (a) Spot rate vs Forward rate  
(b) Foreign exchange risk and Foreign exchange exposure  
(c) Greenfield investment vs Brownfield investment.

किन्हीं दो पर संक्षिप्त टिप्पणी लिखिये:

- (a) स्पॉट दर बनाम अग्रिम दर  
(b) विदेशी विनिमय जोखिम तथा विदेशी विनिमय अनावरण  
(c) ग्रीनफील्ड निवेश बनाम ब्राउनफील्ड निवेश। 15

4. Explain the factors affecting exchange rate determination.

विनिमय दर निर्धारण को प्रभावित करने वाले कारक समझाइये। 15

P. T. O.

Or (अथवा)

Explain purchasing power parity and interest rate parity theory of exchange rate with example.

विनिमय दर के क्रय शक्ति समता तथा ब्याज दर समता सिद्धान्तों को समझाइये।

15

5. Write short notes on any *two* of the following:

- (a) Measures for promoting foreign investments into and from India
- (b) SEZ policy of Government of India
- (c) EPRG Framework.

निम्नलिखित में से किन्हीं दो पर संक्षिप्त टिप्पणी कीजिए:

- (a) भारत में तथा भारत से विदेशी निवेश के संवर्द्धन के उपाय
- (b) भारत सरकार की SEZ नीति
- (c) EPRG ढाँचा।

7.5×2

This question paper contains 4+2 printed pages]

Roll No. 

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S. No. of Question Paper : 2253

Unique Paper Code : 32351601 IC

Name of the Paper : Complex Analysis

Name of the Course : B.Sc. (Hons.) Mathematics

Semester : VI

Duration : 3 Hours

Maximum Marks : 75

*(Write your Roll No. on the top immediately on receipt of this question paper.)*

Attempt all parts from Question No. 1.

Each part carries  $1\frac{1}{2}$  marks.

Attempt any *two* parts from question Nos. 2 to 6

Each part carries *six* marks.

1. State True or False. Justify your answer in brief :

(a) A point  $z_0$  of a domain need not be an accumulation point of that domain.

(b)  $\lim_{z \rightarrow 0} \frac{\bar{z}^2}{z} = 0$

P.T.O.

- (c) The function  $f(z) = e^z$  is periodic with period  $2\pi$ .
- (d)  $\log(-ei) = 1 - \frac{\pi}{2}i$ .
- (e) The function  $f(z) = |z|^2$  is analytic at  $z = 0$ .
- (f) Let C denote the boundary of the triangle with vertices at the point  $0$ ,  $3i$ , and  $-4$ , oriented in the counterclockwise direction. Then  $|\int_C (e^z - \bar{z}) dz| \leq 60$ .
- (g) If C is any simple closed contour, in either direction, then  $\int_C \exp(z^3) dz = 0$ .
- (h) If C is the positively oriented unit circle  $|z| = 1$ , then  $\int_C \frac{\exp(2z)}{z^4} dz = \frac{8\pi i}{3}$ .
- (i)  $\text{Res}_{z=0} f(z) = -\frac{1}{3}$ , where  $f(z) = z^2 \sin\left(\frac{1}{z}\right)$ ,  $0 < |z| < \infty$ .
- (j) The function  $f(z) = \frac{1}{\sin\left(\frac{\pi}{z}\right)}$  has no isolated singular point.

2. (a) Prove that a finite set of points cannot have any accumulation point.
- (b) Suppose that  $f(z) = u(x, y) + iv(x, y)$  ( $z = x + iy$ ) and  $z_0 = x_0 + iy_0$ ,  $w_0 = u_0 + iv_0$ . Then  $\lim_{z \rightarrow z_0} f(z) = w_0$  if and only if  $\lim_{(x,y) \rightarrow (x_0,y_0)} u(x, y) = u_0$  and  $\lim_{(x,y) \rightarrow (x_0,y_0)} v(x, y) = v_0$ .
- (c) Define neighbourhood of the point at infinity. Show that a set S is unbounded if and only if every neighbourhood of the point at infinity contains at least one point in S.
3. (a) Use Cauchy-Riemann equations to show that  $f'(z)$  does not exist at any point if  $f(z) = \exp(\bar{z})$ . State sufficient conditions for differentiability of a function  $f(z)$  at any point  $z_0 = x_0 + iy_0 \in \mathbb{C}$ .
- (b) Suppose that a function  $f(z) = u(x, y) + iv(x, y)$  and its conjugate  $\overline{f(z)} = u(x, y) - iv(x, y)$  are both analytic in a given domain D. Show that  $f(z)$  must be constant throughout D.

- (c) Explain why  $f(x) = \sin(x)$  is a bounded function on  $\mathbb{R}$ , whereas  $f(z) = \sin(z)$  is not a bounded function on the complex plane  $\mathbb{C}$ , although  $\sin^2(z) + \cos^2(z) = 1$  for all  $z \in \mathbb{C}$ .

4. (a) State and prove Cauchy Integral formula.  
 (b) State Liouville's theorem and use it to prove the fundamental theorem of algebra.

- (c) Let  $C$  denote a contour of length  $L$ , and suppose that a function  $f(z)$  is piecewise continuous on  $C$ . Show that

$$\left| \int_C f(z) dz \right| \leq ML, \text{ where } M \text{ is a non-negative constant}$$

such that  $|f(z)| \leq M$  for all points  $z$  on  $C$  at which  $f(z)$  is defined. Hence, show that

$$\left| \int_{C_R} \frac{2z^2 - 1}{z^4 + 5z^2 + 4} dz \right| \leq \frac{\pi R(2R^2 + 1)}{(R^2 - 1)(R^2 - 4)}, \text{ where } C_R$$

denote the upper half of the circle  $|z| = R$  ( $R > 2$ ), taken in the counterclockwise direction.

5. (a) Derive the expansions :

$$(i) \frac{\sinh z}{z^2} = \frac{1}{z} + \sum_{n=0}^{\infty} \frac{z^{2n+1}}{(2n+3)!} \quad (0 < |z| < \infty);$$

$$(ii) z^3 \cosh\left(\frac{1}{z}\right) = \frac{z}{2} + z^3 + \sum_{n=1}^{\infty} \frac{1}{(2n+2)!}$$

$$\frac{1}{z^{2n-1}} \quad (0 < |z| < \infty)$$

- (b) Give all the Laurent series expansions in powers of  $z$  for the function  $f(z) = \frac{-1}{(z-1)(z-2)}$  and specify the domains in which those expansions are valid.

- (c) If a power series  $\sum_{n=0}^{\infty} a_n(z-z_0)^n$  converges when  $z = z_1$  ( $z_1 \neq z_0$ ), then show that it is absolutely convergent at each point  $z$  in the open disk  $|z - z_0| < R_1$  where  $R_1 = |z_1 - z_0|$ .

6. (a) Show that the singular point of each of the following functions is a pole. Determine the order  $m$  of that pole and the corresponding residue B.

$$(i) f(z) = \frac{z^2 - 2z + 3}{z - 2}$$

$$(ii) f(z) = \frac{\sinh z}{z^4}$$

$$(iii) f(z) = \frac{\exp(2z)}{(z-1)^2}$$

- (b) Use residues to evaluate  $\int_0^{2\pi} \frac{d\theta}{5 + 4 \sin \theta}$



(c) If a function  $f$  is analytic everywhere in the finite plane except for a finite number of singular points interior to a positively oriented simple closed contour  $C$ , then show

that  $\int_C f(z) dz = 2\pi i \operatorname{Res}_{z=0} \left[ \frac{1}{z^2} f\left(\frac{1}{z}\right) \right]$ . Use it to show

that  $\int_C \frac{5z - 2}{z(z - 1)} dz = 10\pi i$ , where  $C$  is the circle  $|z| = 2$ ,

described counterclockwise.

This question paper contains 4+2 printed pages]

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S. No. of Question Paper : 2843

Unique Paper Code : 32357611 IC

Name of the Paper : Linear Programming and Theory of Games

Name of the Course : B.Sc. (Hons.) Mathematics-DSE-4

Semester : VI

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any two parts from each question.

All questions carry equal marks.

1. (a) Find all the basic feasible solutions of the following equations :

$$x_1 + x_2 + 2x_3 = 9$$

$$3x_1 + 2x_2 + 5x_3 = 22$$

- (b) Let  $(x_B, 0)$  be a basic feasible solution with objective function value  $z_B$  for LPP :

Maximize  $z = cx$

subject to

$$Ax = b$$

$$x \geq 0.$$

P.T.O.

By entering an  $a_j$  with  $z_j - c_j < 0$  and removing a  $b_r$ ,  
subject to

$$\frac{x_{Br}}{y_{rj}} = \text{Min} \left[ \frac{x_{Bi}}{y_{ij}} : y_{ij} > 0 \right]$$

Show that we can get a new feasible solution with  
improved value of the objective function compared to  
 $Z_B$ .

- (c) Using simplex method, solve the following system of  
equations :

$$8x_1 + 2x_2 = 15$$

$$5x_1 + 3x_2 = 19.$$

2. (a) Solve the following problem by two-phase method :

$$\text{Maximize } z = -x_1 - 2x_2$$

subject to :

$$3x_1 + 4x_2 \leq 12$$

$$2x_1 - x_2 \geq 2$$

$$x_1, x_2 \geq 0.$$

- (b) Solve the following linear program by the big-M method :

$$\text{Minimize } z = 3x_1 - 3x_2 + x_3$$

subject to

$$x_1 + 2x_2 - x_3 \geq 5$$

$$-3x_1 - x_2 + x_3 \leq 4$$

$$x_1, x_2, x_3 \geq 0.$$

- (c) Consider the following problem :

$$\text{Maximize } z = -3x_1 - 2x_2$$

subject to

$$-x_1 + x_2 \leq 1$$

$$5x_1 + 3x_2 \leq 15$$

$$x_1 \geq 0$$

$$x_2 \geq 3/2$$

Solve the problem graphically.

3. (a) Write the dual problem for the Linear Programming  
problem :

$$\text{Maximize } z = 3x_1 + 5x_2 + 7x_3$$

subject to

$$x_1 + x_2 + 3x_3 = 10$$

$$4x_1 - x_2 + 2x_3 \geq 15$$

$$x_1, x_2 \geq 0, x_3 \text{ is unrestricted.}$$

- (b) Apply principle of duality to solve the linear programming problem :

$$\text{Minimize } z = 2x_1 + 2x_2$$

subject to

$$2x_1 + 4x_2 \geq 1$$

$$x_1 + 2x_2 \geq 1$$

$$2x_1 + x_2 \geq 1$$

$$x_1, x_2 \geq 0.$$

- (c) Use graphical method to solve the dual of the following problem :

$$\text{Min } z = 2x_1 + x_2 + 3x_3 + 6x_4$$

subject to

$$x_1 + x_2 + 3x_3 + 2x_4 \geq 3$$

$$2x_1 + x_2 + x_3 + 3x_4 \geq 2$$

$$x_1, x_2, x_3, x_4 \geq 0.$$

Further, use the complementary slackness theorem to find an optimal solution to the given problem from optimal solution of the dual problem.

4. (a) Solve the following transportation problem :

	D	E	F	Capacity
A	5	1	7	10
B	6	4	6	80
C	3	2	5	15

Requirement 75 20 50

- (b) Solve the following assignment problem :

	V	W	X	Y	Z
A	3	5	10	15	8
B	4	7	15	18	8
C	8	12	20	20	12
D	5	5	8	10	6
E	10	10	15	25	10

- (c) (i) Define in "Two-Person Zero-Sum" game :

(I) Saddle point

(II) Mixed Strategy.

- (ii) Use maximin and minimax principle to solve the game :

3	-1	5
6	4	0
10	8	6

5. (a) Solve the following  $4 \times 2$  game graphically :

$$\begin{array}{c}
 \text{Player B} \\
 \text{Player A} \begin{bmatrix} -2 & 0 \\ 3 & -1 \\ -3 & 2 \\ 5 & -4 \end{bmatrix}
 \end{array}$$

- (b) Use dominance to solve the game :

$$\begin{bmatrix} 1 & 3 & 2 & 7 & 4 \\ 3 & 4 & 1 & 5 & 6 \\ 6 & 5 & 7 & 6 & 5 \\ 2 & 0 & 6 & 3 & 1 \end{bmatrix}$$

- (c) Convert the following game problem, involving "two person; zero-sum game" into a linear programming problem for player A and player B :

$$\begin{array}{c}
 \text{Player B} \\
 \text{Player A} \begin{bmatrix} 3 & -2 & 4 \\ -1 & 4 & 2 \\ 2 & -2 & 6 \end{bmatrix}
 \end{array}$$

This question paper contains 4 printed pages]

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S. No. of Question Paper : 2842

Unique Paper Code : 32357610 IC

Name of the Paper : Number Theory

Name of the Course : B.Sc. (H) Mathematics : DSE-4

Semester : VI

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top (immediately on receipt of this question paper.)

Attempt all questions selecting *eight* parts from section I, *five* parts each from Sections II and III

Section I

(Attempt any *eight* parts)

1. (a) If  $p$  is a prime satisfying  $n < p < 2n$ , show that the binomial coefficient  $\binom{2n}{n} \equiv 0 \pmod{p}$ .
- (b) Find the value of  $\left(\frac{-72}{131}\right)$ .
- (c) Use of theory of congruence to verify that  $89 \mid 2^{44} - 1$ .
- (d) Show that  $\phi(3n) = 3\phi(n)$  if and only if  $3 \mid n$ .

P.T.O.

- (e) Given  $2x - 3(18) + 2(28)$  find all the solutions of the linear Diophantine equation  $18x + 28y = 20$ .
- (f) Define  $\sigma(n)$  for a positive integer  $n$ . Compute  $\sigma(108)$  using multiplicative property.
- (g) Decrypt IABEHEHZR using the linear cipher  $C = P - 7 \pmod{26}$ .
- (h) Test if 2 is a primitive root of 13.
- (i) Find out the number of zeroes in which  $500!$  terminates.
- (j) What is a conjecture? Explain it with Goldbach conjecture.
- (k) Find the remainder when  $2(26!)$  is divided by 29.
- (l) Verify the Gauss theorem on  $\psi$  function with  $n = 18$ .

## Section II

(Attempt any 5 parts)

2. Let  $n = p_1^{a_1} p_2^{a_2} \dots p_r^{a_r}$ , be the prime factorization of the integer  $n > 1$ . If  $f$  is a multiplicative function that is not identically zero, prove that :

$$\sum_{d|n} \mu(d) f(d) = (1 - f(p_1))(1 - f(p_2)) \dots (1 - f(p_r)).$$

3. State and prove Chinese Remainder Theorem.
4. Find the solutions of the system of congruences :  
 $3x + 4y \equiv 5 \pmod{13}$ ,  $2x + 5y \equiv 7 \pmod{13}$
5. Determine all solutions in the positive integers of the following Diophantine equations :  $18x + 5y = 48$ .
6. If  $\gcd(a, 133) = \gcd(b, 133) = 1$ , then show that  $133 \mid (a^{18} - b^{18})$ .
7. Using Wilson's theorem, prove that for any odd prime  $p$  :  
 $1^2, 3^2, 5^2, \dots, (p-2)^2 \equiv (-1)^{\frac{p+1}{2}} \pmod{p}$ .
8. Given  $n \geq 1$ , let  $\sigma_j(n)$  denote the sum of the  $j$ th powers of the positive divisors of  $n$ , that is  $\sigma_j(n) = \sum_{d|n} d^j$ . Show that  $\sigma_4$  is a multiplicative function  $5 \times 5 \frac{1}{2}$

## Section III

(Attempt all five parts)

9. Use the information that 3 is a primitive root of 17 to obtain the eight primitive roots of 17.
10. Solve  $x^2 \equiv 14 \pmod{5^2}$ .
11. A long string of cipher text resulting from a Hill cipher  $C_1 \equiv aP_1 + bP_2 \pmod{26}$ ,  $C_2 \equiv cP_1 + dP_2 \pmod{26}$  revealed that the most frequently occurring two-letter blocks were HO and PP, in that order. Find the values of  $a, b, c$  and  $d$ .

12. Prove that if  $p$  is a prime and  $f(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$ ,  $a_n \not\equiv 0 \pmod{p}$  is a polynomial of degree  $n \geq 1$  with integral coefficients, then the congruence  $f(x) \equiv 0 \pmod{p}$  has at most  $n$  incongruent solutions modulo  $p$ .
13. Let  $n > 1$  and  $\gcd(a, n) = 1$ . If  $a_1, a_2, \dots, a_{\phi(n)}$  are the positive integers less than  $n$  and relatively prime to  $n$ , then show that  $aa_1, aa_2, \dots, aa_{\phi(n)}$  are congruent modulo  $n$  to  $a_1, a_2, \dots, a_{\phi(n)}$  in some order. 5×5½



This question paper contains 4+2 printed pages]

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S. No. of Question Paper : 2710

Unique Paper Code : 32357607 IC

Name of the Paper : Probability Theory & Statistics

Name of the Course : B.Sc. (Hons.) Mathematics : DSE-3

Semester : VI

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

In all there are six questions.

Question No. 1 is compulsory and it contains seven parts of 3 marks each, out of which any five parts are to be attempted.

In Question Nos. 2 to 6; attempt any two parts from three parts.

Each part carries 6 marks.

Use of scientific calculator is allowed.

1. (i) If  $C_1$ ,  $C_2$  and  $C_3$  are events in  $C$ , then prove that

$$p_1 \geq p_2 \geq p_3$$

where  $p_1 = P(C_1) + P(C_2) + P(C_3)$ ,

$$p_2 = P(C_1 \cap C_2) + P(C_2 \cap C_3) + P(C_1 \cap C_3), \text{ and}$$

$$p_3 = P(C_1 \cap C_2 \cap C_3).$$

P.T.O.

(ii) Given the cumulative distribution function

$$F(x) = 0 \text{ if } x < -1$$

$$= (x + 2)/4, \text{ if } -1 \leq x < 1, \text{ and}$$

$$= 1 \text{ if } 1 \leq x,$$

Compute :

(i)  $P(-1/2 < X \leq 1/2);$

(ii)  $P(X = 1).$

(iii) Let pmf  $p(x)$  be positive at  $x = -1, 0, 1$  and zero elsewhere.

If  $p(0) = \frac{1}{4}$ , find  $E(X^2)$ .

(iv) If the random variable  $X$  has a binomial distribution with the parameters  $n$  and  $\theta$ , then compute the variance,  $\sigma^2$ , of  $X$ .

(v) Let  $F(x, y)$  be the distribution function of  $X$  and  $Y$ . For all real constants  $a < b, c < d$ , show that

$$P(a < X \leq b, c < Y \leq d) = F(b, d) - F(b, c)$$

$$- F(a, d) + F(a, c)$$

(vi) Let  $f_{1/2}^{(x_1/x_2)} = \begin{cases} \frac{c_1 x_1}{x_2^2}, & 0 < x_1 < x_2, 0 < x_2 < 1 \\ 0, & \text{elsewhere} \end{cases}$

be the conditional pdf of  $X_1$  given  $X_2 = x_2$ .

Also let  $f_2(x_2) = \begin{cases} c_2 x_2^4, & 0 < x_2 < 1 \\ 0, & \text{elsewhere} \end{cases}$

be the marginal pdf of  $X_2$ .

Determine  $C_1$  &  $C_2$  and hence the joint pdf of  $X_1$  and  $X_2$ .

(vii) Prove that  $P_{i,j}^{n+m} = \sum_{k=0}^n P_{i,k}^n P_{k,j}^m$ , for all  $n, m$  and all  $i, j$ .

2. (a) Let  $\{C_n\}$  be a decreasing sequence of events, then show that

$$\lim_{n \rightarrow \infty} P(C_n) = P(\lim_{n \rightarrow \infty} C_n) = P(\bigcap_{n=1}^{\infty} C_n)$$

(b) In a lot of 50 light bulbs, there are 2 bad bulbs. An inspector examines five bulbs, which are selected at random and without replacement.

(i) Find the probability of at least one defective bulb among the five.

(ii) How many bulbs should be examined so that the probability of finding at least one bad bulb exceeds

1/2 ?

- (c) Find the cumulative distribution function for the following pdf :

$$f(x) = \begin{cases} 1/3 & 0 < x < 1 \\ 1/3 & 2 < x < 4 \\ 0 & \text{elsewhere} \end{cases}$$

Also find the median.

3. (a) Let  $X$  have the mgf

$$M(t) = e^{t^2/2}, -\infty < t < \infty$$

Find  $E(X^{2k})$  and  $E(X^{2k-1})$ , for  $k = 1, 2, 3, \dots$

- (b) Show by stating all the conditions that the Binomial distribution can be approximated to the Poisson distribution.

- (c) Let  $X$  have the exponential pdf,  $f(x) = \theta^{-1} \exp\{-x/\theta\}$ ,  $0 < x < \infty$ , zero elsewhere. Find the moment generating function of  $X$ , and hence, the mean, and the variance of  $X$ .

4. (i) Let  $X_1$  and  $X_2$  have the joint pdf

$$f(x_1, x_2) = 15x_1^2x_2 \text{ if } 0 < x_1 < x_2 < 1 \\ = 0 \text{ elsewhere}$$

Find the marginal pdf of  $X_1$  and  $X_2$  and compute  $P(X_1 + X_2 \leq 1)$ .

- (ii) Suppose the joint mgf,  $M(t_1, t_2)$ , exists for the random variables  $X_1$  and  $X_2$ . Then show that  $X_1$  and  $X_2$  are independent if and only if  $M(t_1, t_2) = M(t_1, 0) M(0, t_2)$ ; that is, the joint mgf is identically equal to the product of the marginal mgfs.

- (iii) Let  $X_1, X_2$  be two random variables with joint  $p(x_1, x_2) = \frac{1}{2^{x_1+x_2}}$  for  $1 \leq x_i < \infty, i = 1, 2$ , where  $x_1$  and  $x_2$  are integers, zero elsewhere. Determine the joint mgf of  $X_1, X_2$  and show that  $X_1$  and  $X_2$  are independent random variables.

5. (i) Let  $X_1, X_2$  be two random variables with joint pdf

$$f(x_1, x_2) = 4x_1x_2, \text{ if } 0 < x_1 < 1, 0 < x_2 < 1, \\ = 0 \text{ elsewhere}$$

- (a) Is  $E(X_1, X_2) = E(X_1) E(X_2)$  ?  
 (b) Find  $E(3X_2 - 2X_1^2 + 6X_1X_2)$ .
- (ii) Suppose  $(X, Y)$  have a joint distribution with the variances of  $X$  and  $Y$  finite and positive. Denote the means and variances of  $X$  and  $Y$  by  $\mu_1, \mu_2$  and  $\sigma_1^2, \sigma_2^2$  respectively, and let  $\rho$  be the correlation coefficient between  $X$  and  $Y$ . If  $E(Y | X = x)$  is linear in  $x$ , then

$$E(Y | X = x) = \mu_2 + \rho \frac{\sigma_2}{\sigma_1} (x - \mu_1).$$

- (iii) Let the random variables  $X$  and  $Y$  have the joint density function

$$f(x, y) = 1, \text{ if } -x < y < x, 0 < x < 1 \\ = 0, \text{ elsewhere}$$

Show that, on the set of positive probability density, the graph of  $E(Y | x)$  is a straight line, whereas that of  $E(X | y)$  is not a straight line.

6. (a) (i) If  $X$  is a random variable with mean  $\mu$  and variance  $\sigma^2$ , then prove that for any  $k > 0$
- $$P\{|X - \mu| \geq k\} \leq \frac{\sigma^2}{k^2}.$$
- (ii) Find the smallest value of  $k$  in above inequality for which the probability that a random variable will take a value between  $(\mu - k\sigma)$  and  $(\mu + k\sigma)$  is at least 0.99.
- (b) State the Central limit theorem. Let  $X_i, i = 1, 2, \dots, 10$  be independent random variables, each having uniformly distributed over  $(0, 1)$ . Estimate  $P\{\sum_{i=1}^{10} X_i > 7\}$ .
- (c) An urn always contains 2 balls. Ball colors are red and blue. At each stage a ball is randomly chosen and then replaced by a new ball, which with probability 0.8 is the same color, and with probability 0.2 is the opposite color, as the ball it replaces. Define an appropriate Markov chain and if initially both balls are red, find the probability that the fifth ball selected is red.

This question paper contains 4 printed pages]

Roll No.

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S. No. of Question Paper : 2254

Unique Paper Code : 32351602 IC

Name of the Paper : Ring Theory and Linear Algebra- II

Name of the Course : B.Sc. (Hons.) Mathematics

Semester : VI

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any two parts from each of the questions.

1. (a) Let  $f(x) = x^3 + 2x + 4$  and  $g(x) = 3x + 2$  in  $\mathbb{Z}_5[x]$ . Determine the quotient and remainder upon dividing  $f(x)$  by  $g(x)$ .
  - (b) State and prove Eisenstein's criterion of irreducibility.
  - (c) If  $D$  is a principal ideal domain, prove that every strictly increasing chain of ideals  $I_1 \subset I_2 \subset I_3 \dots$  must be finite in length. Hence, prove that every non-zero and a non-unit element of  $D$  has an irreducible factor. 6.5, 6.5, 6.5
2. (a) Prove that the ideal  $\langle x \rangle$  in  $\mathbb{Q}[x]$  is maximal.
  - (b) (i) Prove that  $8x^3 - 6x + 1$  is irreducible over  $\mathbb{Q}$ .
  - (ii) Prove that the product of two primitive polynomials is primitive.
  - (c) Prove that in a principal ideal domain, an element is irreducible if and only if it is prime. 6,6,6

P.T.O.

3. (a) Suppose that  $V$  is a finite dimensional vector space with the ordered basis  $\beta = \{x_1, x_2, \dots, x_n\}$ . Let  $f_i (1 \leq i \leq n)$  be the  $i$ th coordinate function with respect to  $\beta$  be defined such that  $f_i(x_j) = \delta_{ij}$  where  $\delta_{ij}$  is the Kronecker delta. Let  $\beta^* = \{f_1, f_2, \dots, f_n\}$ . Then prove that  $\beta^*$  is an ordered basis for  $V^*$ , and, for any  $f \in V^*$ , we have

$$f = \sum_{i=1}^n f(x_i) f_i.$$

- (b) For  $A = \begin{pmatrix} 1 & 2 \\ 3 & 2 \end{pmatrix} \in M_{2 \times 2}(\mathbb{R})$ , determine the eigen values

of  $A$  and eigen space corresponding to each eigen value of  $A$ . Also, if possible, find a basis for  $\mathbb{R}^2$  consisting of eigen vectors of  $A$ .

- (c) Prove that the characteristic polynomial of any diagonalizable linear operator splits. Is the converse true? Justify. 6.5, 6.5, 6.5

4. (a) Let  $T$  be a linear operator on  $\mathbb{R}^3$  such that :  
 $T(a, b, c) = (a + b + c, a + b + c, a + b + c)$ .  
 Let  $W = \{(t, t, t) \mid t \in \mathbb{R}\}$  be a subspace of  $\mathbb{R}^3$ . Show that :
- (i)  $W$  is a  $T$ -invariant subspace of  $\mathbb{R}^3$ .
- (ii) The characteristic polynomial of  $T_W$  divides the characteristic polynomial of  $T$ .

- (b) Let  $D$  be the differentiation operator on  $P(\mathbb{R})$ , the space of polynomials over  $\mathbb{R}$ . Prove that there exists no polynomial  $g(t)$  for which  $g(D) = T_0$ . Hence, show that  $D$  has no minimal polynomial.

- (c) Let  $T$  be a linear operator on a finite dimensional vector space  $V$  and let  $p(t)$  be the minimal polynomial of  $T$ . Prove that a scalar  $\lambda$  is an eigen value of  $T$  if and only if  $p(\lambda) = 0$ . 6, 6, 6

5. (a) Let  $V$  be an inner product space. Prove that :

(i)  $\|x \pm y\|^2 = \|x\|^2 \pm 2\operatorname{Re}\langle x, y \rangle + \|y\|^2$  for all  $x, y \in V$  where  $\operatorname{Re}\langle x, y \rangle$  denotes the real part of the complex number  $\langle x, y \rangle$ .

(ii)  $|\|x\| - \|y\|| \leq \|x - y\|$  for all  $x, y \in V$ .

- (b) Suppose that  $S = \{v_1, v_2, \dots, v_k\}$  is an orthonormal set in an  $n$ -dimensional inner product space  $V$ . Show that :

(i)  $S$  can be extended to an orthonormal basis  $\{v_1, v_2, \dots, v_k, v_{k+1}, \dots, v_n\}$  for  $V$ .

(ii) If  $W = \operatorname{span}(S)$  then  $S_1 = \{v_{k+1}, \dots, v_n\}$  is an orthonormal basis for  $W^\perp$ .

(iii) If  $W$  is any subspace of  $V$ , then  $\dim V = \dim W + \dim W^\perp$ .

5

- (c) Find the orthogonal projection of the given vector on the given subspace  $W$  of the inner product space :

$$V = \mathbb{R}^3, u = (2, 1, 3) \text{ and}$$

$$W = \{(x, y, z) : x + 3y - 2z = 0\}. \quad 6.5, 6.5, 6.5$$

- 6. (a) State and prove Bessel's inequality.
- (b) For the inner product space  $V$  over  $F$  and linear transformation  $g : V \rightarrow F$ , find a vector  $y$  such that  $g(x) = \langle x, y \rangle$  for all  $x \in V$  where :

$$V = P_2(\mathbb{R}) \text{ with } \langle f, h \rangle = \int_0^1 f(t)h(t)dt, \text{ and}$$

$$g(f) = f(0) + f'(1).$$

- (c) Let  $V$  be a complex inner product space and let  $T$  be a linear operator on  $V$ .

$$\text{Define } T_1 = \frac{1}{2}(T + T^*) \text{ and } T_2 = \frac{1}{2i}(T - T^*)$$

- (i) Prove that  $T_1$  and  $T_2$  are self adjoint and that  $T = T_1 + iT_2$ .
- (ii) Suppose also that  $T = U_1 + iU_2$  where  $U_1$  and  $U_2$  are self-adjoint. Prove that  $U_1 = T_1$  and  $U_2 = T_2$ .
- (iii) Prove that  $T$  is normal if and only if  $T_1T_2 = T_2T_1$ .

6,6,6

10/5/19(m)

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**Your Roll No.** : .....

**Sl. No. of Q. Paper** : **2281**      **IC**

Unique Paper Code : 32371601

Name of the Course : **B.Sc. (Hons.) Statistics**

Name of the Paper : Design of Experiments

Semester : VI

**Time : 3 Hours**                      **Maximum Marks : 75**

**Instructions for Candidates :**

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
  - (b) Attempt **five** questions in all.
  - (c) Question **No.1** is compulsory.
  - (d) Attempt **four** questions from the remaining questions.
1. (a) Suppose an experiment with a single factor at five levels was conducted using a CRD. Each level of the factor is randomly assigned three experimental units. Write down the appropriate linear model. How many degrees of freedom are available for estimating the error variance ?                      3

P.T.O.



(b) Suppose we have  $v$  treatments to be compared in  $v^2$  plots. Name the design under each of the following situations : 3

(i) There is no fertility difference among the  $v$  plots,

(ii) The fertility changes along a particular direction, and

(iii) The fertility changes along two perpendicular directions.

(c) Given a BIBD : 3

1 2 3 4 5 6 7

2 3 4 5 6 7 1

4 5 6 7 1 2 3

with  $v = 7, b = 7, r = 3, k = 3, \lambda = 1$ .

Write down its (i) complementary and (ii) residual designs along with their parameters.

(d) What is a treatment contrast ? When are two contrasts said to be orthogonal ? 3

(e) Following is the principal block of a  $2^4$  factorial experiment : 3

(0000, 0101, 1010, 1111)

Write down the contents of the other blocks and identify the confounded effects.

2. (a) Explain the principles of replication, randomization and local control in experimental designs. How are these principles used in RBD and LSD ? 9

(b) Derive the expected value of mean sum of squares due to errors and treatments in LSD. Also, show that under the truth of null hypothesis, the mean sum of squares due to treatments gives an unbiased estimate of error variance. 6

3. (a) What is meant by a missing plot ? Give the complete statistical analysis of an RBD with one missing observation. 9

(b) Explain the concept of efficiency of a design and discuss how it can be increased. Derive the expression to measure the efficiency of LSD over CRD. 6

4. (a) Define a BIBD with parameters  $v, b, r, k$  and  $\lambda$ . State and prove the **three** basic relationships among its parameters. 8

(b) Derive a necessary condition for the existence of a symmetric BIBD with even number of treatments. 3

(c) For a resolvable BIBD with parameters  $v, b, r, k$  and  $\lambda$ , prove that  $b \geq v + r - 1$ . 4

5. (a) What is meant by confounding in factorial experiments? Distinguish between partial and total confounding. Construct a system of partial confounding for a  $3^2$  factorial experiment in blocks of size 3 with 6 blocks so that at least partial information can be obtained about two factor interaction components and full information about the main effects. 9
- (b) Describe Yates algorithm for computing the total effects and the sum of squares due to various effects for a  $2^3$  factorial experiment laid out in  $r$  randomized blocks. 6
6. (a) A  $2^5$  design is to be arranged in  $2^2$  blocks of size  $2^3$  each. Suggest a suitable set of 3 degrees of freedom to be confounded such that information on main effects and first order interactions is not at all lost. Also write down the treatment combinations of all the blocks. 6
- (b) What are fractional factorial designs? Construct a  $2^{5-2}$  design with defining relations  $I = ABD$  and  $I = -BCDE$ . Also, write the alias structure of this design and identify its resolution. 9

This question paper contains 4+2 printed pages]

Roll No.

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S. No. of Question Paper : 2740

Unique Paper Code : 32377911 IC

Name of the Paper : Financial Statistics

Name of the Course : B.Sc. (H) Statistics : DSE-3

Semester : VI

Duration : 3 Hours Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt five questions in all.

Section I is compulsory.

Select two questions from each of the Sections II and III.

Use of non-programmable calculator is permitted.

#### Section I

I. Attempt any five parts. All parts carry equal marks.

(a) Explain 'The Comparison Principle' with an example in the context of financial markets.

(b) If the amount ' $P$ ' is borrowed for ' $t$ ' years at a nominal interest rate of ' $r$ ' per year compounded continuously, then show that the amount at time ' $t$ ' is ' $Pe^{rt}$ '.

P.T.O

- (c) An investor borrows money at an effective rate of interest of 10% p.a. to invest in a 5-year project. The cash flows for the project are :
  - an initial outlay of £25,000
  - an income of £20,000 p.a. each during the fourth and fifth years (assumed to be payable continuously)
  - a decommissioning expense of £25,000 at the end of the 3rd year.

Calculate the NPV of this project.

- (d) Define 'intrinsic value' of a call and put option at time  $t$ . Under what conditions is an option said to be 'in-the-money', 'at-the-money', and 'out-of-the-money' ?
- (e) Define the strategy called 'straddle' and draw the corresponding payoff table.
- (f) Consider a forward contract on a non-dividend paying share for which the stock price process is an Ito-process. If  $r$  is the risk free rate of interest, and  $V_t = S_0 e^{rt}$ ;  $0 \leq t, T < 1$  is the price of a forward, then find the SDE of the forward contract maturing at time  $T$ .

- (g) Obtain 'theta' of a European put option.
- (h) Let  $W_t$  be a standard Wiener process. Define  $X_t = W_t + 4t$ . Check if  $X_t$  is a martingale with respect to  $F_t$ , the filtration associated with  $W_t$ .  $5 \times 5 = 25$

Section II

- 2. (a) Consider two possible sequences of end-of-year returns :
  - (10, 20, 20, 15, 10, 5) and (10, 10, 15, 20, 20, 20)

Which sequence is preferable if the interest rate, compounded annually, were :

- (i) 3%
- (ii) 5%
- (iii) 10% ?

- (b) A perpetual annuity or perpetuity entitles its holder to be paid the constant amount at the end of each of an infinite sequence of years. If the interest rate is compounded yearly, then what is the present value of such a cash flow sequence? If a person is to receive a bank grant of \$1,000 per year at 8% interest, what is the present value of such a cash flow stream ?

(a) For two European calls with the same maturity date  $T$  and delivery prices  $K_1$  and  $K_2$  such that  $K_1 \leq K_2$ , show that at time  $t \leq T$

$$0 \leq C_{K_1,T}(t, S_t) - C_{K_2,T}(t, S_t) \leq (K_2 - K_1) e^{-rt}$$

where  $\tau = T - t$  is the time to maturity and  $r$  denotes the risk-free rate of interest.

(b) Consider the following Binary one period model :

A stock with price  $S_0$  and a European call option on the stock with strike price  $K$ . Determine price  $C_0$  of the call option, the call being valued one period before expiration under the hedge strategy. 6½,6

Section III

(a) Define a Wiener process. Let  $W_t$  be a standard Wiener process. Show that the process defined as  $X_t = (W_t^2; t > 0)$  is also a Wiener process.

(b) Let  $W_t$  be a standard Wiener process. Derive the value of  $E(W_t^4)$ . 6½,6

(a) If a bank offers sweep-account interest at a nominal rate of 6.5% p.a. compounded continuously then what is the effective interest rate per year ? 5,5,2½

(b) Two assets are available for construction of a portfolio, two stocks with corresponding expected returns  $\bar{r}_1$  and  $\bar{r}_2$ , the respective variances  $\sigma_1^2$  and  $\sigma_2^2$  and covariance  $\sigma_{12}$ . Construct a portfolio consisting of the assets so that it has the minimum variance in the class of all portfolios consisting of these assets.

(c) An investor has a capital of \$10,500 at his disposal to buy stocks whose current price is \$100. Further put options on the same stock with a delivery price of  $K = \$100$  and a time to maturity of 1 year are quoted at a market price of \$5 per contract. Consider two alternative investment plans :

Portfolio A : Buying 105 stocks

Portfolio B : Buying 100 stocks for 10,000 and buying 100 put options for 500.

Discuss the effect of portfolio insurance on portfolio value and return. 6½,6

(7)

6. (a) Let  $\{X_t; t \geq 0\}$  be an Itô-process given by :

$$dX_t = \mu(t, X_t)dt + \sigma(t, X_t)dW_t$$

Further let  $Y_t = g(t, X_t)$  is a differentiable function of  $t$  and  $X_t$ . Obtain the SDE for  $\{Y_t; t \geq 0\}$ .

- (b) For a derivative based on a stock whose price process is an Itô-process, show that, in usual notations :

$$rF = \Theta + rS\Delta + \frac{1}{2}\sigma^2 S^2 \Gamma \quad 6/5,6$$

7. (a) Let a put option with exercise price  $K = \$8$  at  $T = 2$ , be priced at  $t = 0$ . The current stock price is \$10 which is expected to increase by 10% or decrease by 20% in the first period. For the second period, the stock price is expected to increase by 20% or decrease by 10%. Assuming the risk free rate of interest to be 0%, find the value of the call at  $t = 0$ .

- (b) Let the current price of a stock be \$50. The risk free rate is 10% and volatility associated with the stock price movement is 20%. Find the price of a put in 3 months if the exercise price is \$55. Use put call parity to determine the price of call on this stock.

[This question paper contains 7 printed pages]

**Your Roll No.** : .....

**Sl. No. of Q. Paper** : **2282** IC

Unique Paper Code : 32371602

Name of the Course : **B.Sc. (Hons.) Statistics**

Name of the Paper : Multivariate Analysis and  
Nonparametric Methods

Semester : VI

**Time : 3 Hours** **Maximum Marks : 75**

**Instructions for Candidates :**

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Question **No.1** is compulsory.
- (c) Attempt **five** more questions selecting **three** questions from **section-I** and **two** questions from **section-II**.
- (d) Use of simple calculator is allowed.

**1. Compulsory question :**

- (a) Fill in the blanks : 1×5=5
  - (i) Discriminant analysis is a ..... technique.

P.T.O.

(ii) Given that  $\underline{X} \sim N_3(\mu, \Sigma)$  with

$$\Sigma = \begin{bmatrix} 4 & 1 & 0 \\ 1 & 3 & 0 \\ 0 & 0 & 2 \end{bmatrix}, (x_1, x_2) \text{ and } x_3 \text{ are } \dots\dots\dots$$

(independent/dependent.)

(iii) U-test can be applied when the measurement are atleast in ..... scale.

(iv) In case of SPRT, if  $\frac{L_m}{L_0} \leq \frac{\beta}{1-\alpha}$  then we terminate the process .....

(v) The formula for  $R_{1,23}^2 = \dots\dots\dots$

(b) (i) Find the number of runs and the length of each run in the following data : 2

M M F F F M M M F M M F F F .

(ii) For a SPRT of strength  $(\alpha', \beta')$  and show that  $\alpha' + \beta' \leq \alpha + \beta$  2

given  $A = \frac{1-\beta}{\alpha}, B = \frac{\beta}{1-\alpha}$

(c) (i) Determine the parameters for the BVN distribution

$$f(x, y) = c \exp$$

$$\left\{ -\left[ 16(x-2)^2 - 12(x-2)(y+3) + 9(y+3)^2 \right] / 216 \right\}.$$

(ii) Let  $(X, Y) \sim \text{BVN}(\mu_1, \mu_2, \sigma_1^2, \sigma_2^2, \rho)$ . Derive

the distribution of  $Z = \frac{X - \mu_1}{Y - \mu_2}$  3

**Section - I**

2. (a) If  $\underline{X}, \underline{\mu}$  and  $\Sigma$  are partitioned as

$$\underline{X} = \begin{pmatrix} X^{(1)} \\ \sim_{q \times 1} \\ X^{(2)} \\ \sim_{(p-q) \times 1} \end{pmatrix}, \quad \underline{\mu} = \begin{pmatrix} \mu^{(1)} \\ \sim \\ \mu^{(2)} \\ \sim \end{pmatrix} \quad \text{and}$$

$$\Sigma = \begin{pmatrix} \Sigma_{11} & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{22} \end{pmatrix} \text{ then show that } X^{(1)} \text{ and } X^{(2)}$$

are independently distributed if  $\Sigma_{12} \Sigma_{21} = 0$  6



(b). Verify the relation  $\Sigma = LL' + \psi$  for two

factors when  $\Sigma = \begin{bmatrix} 19 & 30 & 2 & 12 \\ 30 & 57 & 5 & 23 \\ 2 & 5 & 38 & 47 \\ 12 & 23 & 47 & 68 \end{bmatrix}$

$$L = \begin{bmatrix} 4 & 1 \\ 7 & 2 \\ -1 & 6 \\ 1 & 8 \end{bmatrix}$$

Hence show that  $V(X_i) = \text{Communality} + \text{Specific variance}$ ;  $(i = 1, 2, 3, 4)$  6

3. (a) Explain briefly the Factor Analysis. 5

(b) If X and Y are standard normal variates with coefficient of correlation  $\rho$ , then

(i) Show that  $X + Y$  and  $X - Y$  are independently distributed.

(ii) Obtain the distribution of

$$Q = \frac{X^2 + Y^2 - 2\rho XY}{1 - \rho^2}$$
 7

4. (a) Let the joint density of r. v. s x and y be given by

$$f(x, y) = \frac{1}{2\pi} \exp\left[-\frac{(x^2 + y^2)}{2}\right] \times$$

$$\left[1 + xy \exp\left\{-\frac{(x^2 + y^2 - 2)}{2}\right\}\right]; -\infty < (x, y) < \infty.$$

(i) Verify that f(x, y) is a p. d. f.

(ii) Show that the marginal distributions of each of X and Y are normal.

(iii) Are X and Y independent? 7

(b) Let  $(X, Y) \sim \text{BVN}(\mu_1, \mu_2, \sigma_1^2, \sigma_2^2, \rho)$ . Show that X and Y are independent iff  $\rho = 0$ . 5

5. (a) Drive the moment generating function for  $(X, Y) \sim \text{BVN}(\mu_1, \mu_2, \sigma_1^2, \sigma_2^2, \rho)$ . 5

(b) If  $(X, Y) \sim \text{BVN}(0, 0, 1, 1, \rho)$  then show that moments obey the recurrence relation

$$\mu_{rs} = (r+s-1)\rho\mu_{r-1,s-1} + (r-1)(s-1)(1-\rho^2)\mu_{r-2,s-2}$$

Hence show that  $\mu_{31} = 3\rho$  and  $\mu_{22} = 1 + 2\rho^2$ .

- 8. Define Run and length of Run. Develop Run Test, in detail, for two samples. Discuss the situation for Ties. How do you apply Run Test for randomness of given data? 12

Section - II

- 6. (a) Describe the SPRT, OC function and ASN function for testing simple  $H_0 : \theta = \theta_0$  against simple  $H_1 : \theta = \theta_1$  for a distribution with p. d. f. / p. m. f.  $f(x : \theta)$ . 5
- (b) Determine the SPRT for testing  $H_0 : \theta = \theta_0$  against  $H_1 : \theta = \theta_1$  where  $\theta$  is parameter of Poisson distribution. Also, find approximation to the OC function and ASN functions of the test. 7
- 7. (a) Develop Wilcoxon-Mann-Whitney test in detail. How do you proceed when ties occur? Carry out the process for large samples. 8
- (b) Distinguish between parametric and Non-Parametric test. 4

This question paper contains 4+1 printed pages]

Roll No.

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S. No. of Question Paper : 2871

Unique Paper Code : 32377910

IC

Name of the Paper : Survival Analysis and Bio-Statistics

Name of the Course : B.Sc. (Hons) Statistics : DSE-4

Semester : VI

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt five questions in all.

Question no. 1 is compulsory.

Select four questions from the remaining questions.

Use of simple calculator is allowed.

1. (a) Construct a survival model in which hazard rate is constant. Find mean and variance of the survival time.
- (b) Distinguish between type I and type II censoring with the help of biological examples.

P.T.O.

- (c) Find the death density function due to risk  $R_i$  ( $i=1,2, \dots, k$ ), when competing risks are dependent.
- (d) What are the factors by which an epidemic is characterized? Distinguish between simple and general epidemic models.
- (e) What is the importance of chromosomes in Genetics? Distinguish between Genotype and Phenotype.  $5 \times 3 = 15$
2. (a) For the following survival data of female patients with Angina Pectoris; define and compute survival function, death density function and hazard function.

Year after diagnosis	No. of patients alive at the beg of the interval	No. of deaths in the interval
0-1	555	82
1-2	473	65
2-3	408	47
3-4	361	35
4-5	326	32

5-6	294	26
6-7	268	21
7-8	247	18
8-9	229	9

- (b) Estimate Crude probability of death using the method of maximum likelihood. Also find  $E(\hat{Q}_{15})$ ,  $\text{Var}(\hat{Q}_{15})$ ,  $\text{Cov}(\hat{Q}_{15}, \hat{Q}_{18})$  ( $\delta \neq \epsilon$ ). 7, 8
3. (a) Suppose that in an experiment 12 mice are exposed to carcinogens. The experimenter decides to terminate the study after 9 mice are dead. The survival times (in weeks) are as follows :
- 5, 8, 9, 10, 12, 15, 20, 21, 25, 25+, 25+, 25+
- Assuming that the times of death of these mice follow exponential distribution, describe the data and estimate the mean survival time, survival rate and variance of the estimated mean survival time.
- (b) If  $g_i^j$  ( $i = 1, 2, 3, 4; j = 1, 2, 3, \dots$ ) denote the probability of  $i^{\text{th}}$  type of gamete in the  $j^{\text{th}}$  generation then under random mating obtain  $g_i^n$  ( $i = 1, 2, 3, 4$ ) after defining standard notations. 7, 8

4. (a) Consider the following tumor free time in days of the 10 rats on a low fat diet. Calculate Kaplan Meier estimates of  $S(t)$  for all rats and standard error of  $S(t)$  at  $t=65$  and  $66$ .

Rat No.	Tumor free time
4	50
6	56
1	65
7	66
8	73
5	77
3	84
9	86
2	87
10	110

- (b) What is blinding? Describe single, double and triple blinding? 8, 7

5. (a) Explain life table method to estimate the survival function. Also compute the variance of the estimate of survival function.
- (b) How will you define duration of an epidemic? If an epidemic is initiated by 10,000 susceptibles and 1 infective with infection rate 0.002, then determine the probability of no susceptible getting infected till 8 units of time. 8, 7
6. (a) If  $Y_1$  and  $Y_2$  are two random variables representing the longevities under two correlated competing risks  $R_1$  and  $R_2$  respectively, and if  $Y_1, Y_2 \sim \text{BVN}(\mu_1, \mu_2, \sigma_1^2, \sigma_2^2, \rho)$  then obtain the conditional death density function of  $Y_1/Y_2$ .
- (b) (i) Prove that, under random mating, genotypic array is the square of the gametic array.
- (ii) Give the concept of coupling and repulsion. 7, 8