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<b>PAPER CODE</b>  <b>22123</b>	<b>PAPER – II</b> <b>MECHANICAL</b> <b>ENGINEERING</b> <b>(English)</b>	<b>Question Booklet</b> <b>Number</b>	 <b>Question Booklet Number</b>
<b>EEA-1222</b>			

**Duration : 150 Minutes****Max. Marks : 300****INSTRUCTIONS TO CANDIDATES**

- Before opening the seal of the Question Booklet check whether the Paper Code printed on it is matching with the Paper Code printed on the Hall Ticket with the respective session. If it is not matching, immediately bring to the notice of the invigilator and obtain the Question Booklet with correct Paper Code.
- Please check the Question Booklet immediately on opening and ensure that it contains all the 150 multiple choice questions printed on it.
- Carefully note the Question Booklet No.
- Separate Optical Mark Reader (OMR) Answer Sheet is supplied to you. The OMR Answer sheet contains boxes for filling Hall Ticket Number, Question Booklet Number, Paper Code, Signature of the Candidate and Invigilator. Fill the boxes with Blue/Black ball point pen only.
- If there is any defect in the Question Paper Booklet or OMR answer sheet, please ask the invigilator for replacement immediately.
- Since the answer sheets are to be scanned (valued) with Optical Mark Scanner system, the candidates have to USE BALL POINT PEN (BLUE/BLACK) ONLY for darkening the circles in the OMR Sheet including bubbling the answers. Bubbling with Pencil / Ink Pen /Gel Pen is not permitted in the examination. If any mistake is done by you on the OMR sheet, it will not be replaced.
- The Question Booklet number is printed on right corner of the cover page of the Test Booklet. Mark your Question Booklet number on side 1 of the OMR Answer Sheet by darkening the appropriate circles with Blue/Black ball point pen.

**అభ్యర్థులకు సూచనలు**

- ప్రశ్న పత్రం యొక్క సీల్‌ను తెరిచే ముందు దాని పైన ముద్రించిన ఉన్న పేపర్ కోడ్ ను మీ హాల్ టికెట్‌లో ముద్రించబడిన ఆ సెషన్‌కు సంబంధించిన పేపర్ కోడ్‌తో సరిపోల్చుకోండి. ఒక వేళ ఆ రెండూ ఒక దానికొకటి భిన్నంగా ఉన్నచో ఆ విషయాన్ని ఇన్విజిలేటర్ దృష్టికి వెంటనే తీసుకెళ్ళి సరైన పేపర్ కోడ్ ఉన్న ప్రశ్న పత్రాన్ని అడిగి తీసుకోండి.
- ప్రశ్న పత్రాన్ని తెరిచిన వెంటనే అందులోని 150 ప్రశ్నలు వాటికిచ్చిన అక్షరాలను అన్ని సరిగ్గా ముద్రించబడాయో లేదో జాగ్రత్తగా పరిశీలించండి.
- క్యెస్టన్ బుక్‌నెంబర్ నంబర్‌ను జాగ్రత్తగా పరిశీలించండి.
- సమాధానాలను గుర్తించడానికి ప్రత్యేకంగా OMR సమాధాన పత్రాన్ని ఇవ్వడం జరుగుతుంది. అందులో హాల్ టికెట్ నంబరు, క్యెస్టన్ బుక్‌నెంబర్ నంబర్, పేపర్ కోడ్, అభ్యర్థి సంకేతం, ఇన్విజిలేటర్ సంకేతాలకు సంబంధించిన వివరాలు నింపడానికి గడులు కేటాయించబడి ఉంటాయి. గడులను నింపటానికి నీలి/నలుపు (బ్లూ/బ్లాక్) బాల్ పాయింట్ పెన్నులను మాత్రమే ఉపయోగించాలి.
- ప్రశ్న పత్రంలో కానీ, OMR సమాధాన పత్రంలో కానీ ఏమైనా లోపాలుంటే వాటిని మార్చవలసిందిగా వెంటనే ఇన్విజిలేటర్‌ను కోరవచ్చు.
- సమాధాన పత్రాలను ఆప్టికల్ మార్కెటింగ్ వర్క్ షీట్ వద్దతిలో మూల్యాంకనం చేస్తారు. కాబట్టి దానిపైన ఉన్న వృత్తాలను (జవాబులకు సంబంధించిన వృత్తాలతో సహా) నింపటానికి బ్లూ/బ్లాక్ బాల్ పాయింట్ పెన్నులను మాత్రమే ఉపయోగించాలి. పెన్సిల్ లేదా ఇంకు పెన్ను లేదా జెల్ పెన్నులతో బల్బింగ్ చేయటం పరీక్షలో అనుమతించబడదు. OMR పత్రంలో అభ్యర్థి తప్పులు రాసిన/దిద్దిన యెడల దానిని మార్చి ఇంకొకటి ఎట్టి పరిస్థితుల్లో ఇవ్వటం జరగదు.
- ప్రశ్న పత్రం పై క్యెస్టన్ బుక్‌నెంబర్ నంబర్ ముద్రించబడి ఉంటుంది. ఇది ప్రశ్న పత్రం కవర్ పేజీ పై కుడి మూలన ముద్రించబడి ఉంటుంది. ఈ క్యెస్టన్ బుక్‌నెంబర్ నంబర్‌ను మీ సమాధాన పత్రం యొక్క సైడ్-1 లో దానికి కేటాయించబడిన స్థలంలో బ్లూ/బ్లాక్ బాల్ పాయింట్ పెన్నుతో జాగ్రత్తగా నింపాలి.



Example to fill up the Question Booklet number.  
If your Question Booklet number is 102365, please fill as shown below :

Question Booklet No.

1	0	2	3	6	5
●	①	①	①	①	①
②	②	●	②	②	②
③	③	③	●	③	③
④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	●
⑥	⑥	⑥	⑥	●	⑥
⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨
⑩	●	⑩	⑩	⑩	⑩

If you have not darkened the Question Booklet number at side 1 of the OMR Answer Sheet your Answer Sheet will be invalidated without any further notice. If it is darkened in a way that it leads to discrepancy in determining the exact Question Booklet number, then it may lead to wrong result / rejection of the Answer Sheet and candidate himself / herself will be responsible for the same.

8. Each question is followed by 4 answer choices. Of these, you have to select one correct answer and mark it on the Answer sheet by darkening the appropriate circle for the question. If more than one circle is darkened, that answer will not be valued at all. Use Blue/Black Ball point pen to fill the circle completely. Make no other stray marks.

e.g. : If the answer for Question No. 1 is Answer choice (2), it should be marked as follows :

①	●	③	④
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9. Mark your Hall Ticket No. as given in the Hall Ticket with Blue/Black Ball point pen by darkening appropriate circles in side 1 of the OMR Answer Sheet. Incorrect/ not encoding of Hall Ticket no. will lead to invalidation of your Answer Sheet and also will lead to rejection of your candidature without any further notice.

Example : If the Hall Ticket No. is 1309102001, fill as shown below :

Hall Ticket Number

1	3	0	9	1	0	2	0	0	1
●	①	①	①	●	①	①	①	①	●
②	②	②	②	②	●	②	②	②	②
③	●	③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	●	⑨	⑨	⑨	⑨	⑨	⑨
⑩	⑩	●	⑩	⑩	⑩	●	⑩	⑩	⑩

10. Get the signature of the Invigilator affixed in the space provided in the answer sheet. Candidate should sign in the space provided in the OMR Answer Sheet.

క్యెజ్టన్ బుక్లెట్ నంబర్ నింపడానికి  
ఉదా : ఒకవేళ మీ క్యెజ్టన్ బుక్లెట్ నంబర్ 102365 అయితే దాన్ని కింది విధంగా నింపాలి.

Question Booklet No.

1	0	2	3	6	5
●	①	①	①	①	①
②	②	●	②	②	②
③	③	③	●	③	③
④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	●
⑥	⑥	⑥	⑥	●	⑥
⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨
⑩	●	⑩	⑩	⑩	⑩

OMR సమాధాన పత్రం యొక్క సైడ్-1 లో మీ క్యెజ్టన్ బుక్లెట్ నంబర్ను నింపక పోయినచో ఎటువంటి నోటీసు ఇవ్వకుండానే మీ సమాధాన పత్రం మూల్యాంకనం నిలిపివేయబడును. ఒకవేళ దానిని సరిగ్గా గుర్తించేలా నింపక పోయినచో ఫలితం తప్పగా వచ్చే అవకాశం లేదా మీ సమాధాన పత్రం తిరస్కరింపబడే అవకాశం వుంటుంది. దానికి అభ్యర్థి పూర్తి బాధ్యత వహించాల్సి వుంటుంది.

8. ప్రతి ప్రశ్నకు నాలుగు ఐచ్ఛికాలు ఇవ్వబడతాయి. వీటిలో ఒకదానిని సమాధానంగా ఎంచుకోవాలి. సమాధాన పత్రంలో దానికి సంబంధించిన వృత్తాన్ని నింపవలెను. ఒకటి కన్నా ఎక్కువ వృత్తాలను నింపినచో ఆ సమాధానం పరిగణించబడదు. వృత్తాలను పూర్తిగా నింపడానికి బ్లూ/బ్లాక్ బాల్ పాయింట్ పెన్సులను మాత్రమే ఉపయోగించాలి. మరే విధమైన గీతలు గీయటం గాని మరకలను అంటించటం గాని చేయరాదు.

ఉదా : 1 వ ప్రశ్నకు సమాధానం (2) అయితే దాన్ని ఈ క్రింది విధంగా నింపాలి.

①	●	③	④
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9. హాల్ టికెట్లో ఇవ్వబడిన హాల్ టికెట్ నంబర్ను బ్లూ/బ్లాక్ బాల్ పాయింట్ పెన్సుతో OMR సమాధాన పత్రపు సైడ్-1 లో ఇవ్వబడిన సరియైన వృత్తాలలో నింపాలి. హాల్ టికెట్ నంబర్ను తప్పగా నింపటం లేదా అస్సలు నింపకపోయినచో మీ సమాధాన పత్రం మూల్యాంకనం చేయబడదు మరియు మీ అభ్యర్థిత్వం ఎటువంటి నోటీసు ఇవ్వకుండానే తిరస్కరించబడును.

ఉదా : హాల్ టికెట్ నంబరు 1309102001 అయితే ఈ క్రింది విధంగా నింపాలి.

Hall Ticket Number

1	3	0	9	1	0	2	0	0	1
●	①	①	①	●	①	①	①	①	●
②	②	②	②	②	●	②	②	②	②
③	●	③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	●	⑨	⑨	⑨	⑨	⑨	⑨
⑩	⑩	●	⑩	⑩	⑩	●	⑩	⑩	⑩

10. సమాధాన పత్రంలో కేటాయింపబడిన స్థలంలో ఇన్వెజిలెటర్ సంతకం తీసుకోవాలి. అభ్యర్థి కూడా OMR సమాధాన పత్రంలో కేటాయించిన స్థలంలో తప్పనిసరిగా సంతకం చేయాలి.



- |   |  |
|---|--|
| <p>11. Rough work should be done only in the space provided for that purpose in the Question Paper Booklet. No other loose sheet of paper will be allowed into the Examination Hall except Hall Ticket.</p> <p>12. Do not mark answer choices on the Question Booklet. Violation of this will be viewed seriously.</p> <p>13. Use of Calculators, Mathematical Tables, Log Books, Pagers, Cell Phones or any other electronic gadgets is strictly prohibited.</p> <p>14. The candidate should write the Booklet number and Sign in the space provided in the Nominal Rolls while ensuring the Bio-data printed against his/ her name is correct.</p> <p>15. No candidate should leave the examination hall until completion of examination time.</p> <p>16. Before leaving the examination hall, the candidate should hand over the OMR Answer Sheet to the Invigilator, failing which action will be taken for malpractice.</p> <p>17. Candidates are permitted to take away the Question Paper with them after completion of the exam.</p> <p>18. The OMR Answer Sheet will be invalidated, if the candidate :</p> <ul style="list-style-type: none"> <li>i. writes the Hall Ticket No. in any other place of OMR sheet, except in the space provided for the purpose.</li> <li>ii. writes irrelevant matter, including the religious symbols, words, prayers or any communication whatsoever, in any place of the OMR answer sheet.</li> <li>iii. uses other than Blue/ Black ball point pen to darken the circles.</li> <li>iv. forgets to bubble the Question Booklet number or bubble multiple circles in a row while filling the Question Booklet No. or bubble Hall Ticket No. other than allotted to him/ her.</li> <li>v. resorts to wrong/erroneous/incomplete bubbling of circles or using ✓ or ✗ in the circles.</li> <li>vi. uses whitener on the answer sheet.</li> <li>vii. attempts any type of tampering (rubbing the circles with chalk powder/ scratching the circles with razors etc.) on the OMR Answer Sheet.</li> <li>viii. adopts any method of malpractice.</li> </ul> <p>19. No correspondence will be entertained in this matter by the commission, if the Answer Sheet is invalidated or his / her candidature is rejected due to the above reasons.</p> <p>20. The digital copy of OMR Answer Sheets will be made available in the Commission's website after completion of the Image Scanning.</p> | <p>11. ప్రశ్నా పత్రంలో కేటాయించిన స్థలంలో మాత్రమే చిత్తు పని చేయవలెను. పరీక్ష గదిలోకి హాల్ టికెట్ తప్ప మరే ఇతర ఏడి కాగితాలు అనుమతించబడవు.</p> <p>12. ప్రశ్నా పత్రాలలో సమాధానాలను గుర్తుపెట్టడం తీవ్రంగా పరిగణించబడును.</p> <p>13. పరీక్ష గదిలో కాలిక్యులేటర్లు, మాథమాటికల్ టేబుల్స్, లాగ్ బుక్స్, పేజర్స్, సెల్ ఫోన్స్ లేదా ఏ ఇతర ఎలక్ట్రానిక్ వస్తువులను ఉపయోగించడం నిషిద్ధం.</p> <p>14. నామినల్ రోల్స్ లో ముద్రించబడిన తన వ్యక్తిగత వివరాలు సరియైనవని ధృవీకరించుకున్న తర్వాత అభ్యర్థి తనకివ్వబడిన ప్రశ్నాపత్రం యొక్క క్వెస్టన్ బుక్ లెట్ నంబర్ ను నామినల్ రోల్ లో దానికై కేటాయించబడిన స్థలంలో రాసి సంతకం చెయ్యాలి.</p> <p>15. పరీక్ష పూర్తయ్యే వరకు ఏ ఒక్క అభ్యర్థి కూడా పరీక్ష గదిని విడిచి వెళ్ళటానికి అనుమతించబడదు.</p> <p>16. పరీక్ష అనంతరం పరీక్ష గది నుండి బయటకు వెళ్ళే ముందు ప్రతి అభ్యర్థి OMR సమాధాన పత్రాన్ని ఇన్వెజిలేటర్ కు తప్పనిసరిగా అప్పగించి వెళ్ళాలి. లేనిచో అతని పై మాల ప్రాక్టీస్ కింద చర్యలు తీసుకోబడును.</p> <p>17. పరీక్ష అనంతరం ప్రశ్నా పత్రాన్ని అభ్యర్థులు తమ వెంట తీసుకొని వెళ్ళవచ్చు.</p> <p>18. ఒక అభ్యర్థి క్రింది ఏ చర్యలకు పాల్పడినను అతని సమాధాన పత్రం మూల్యాంకనం చేయబడదు.</p> <ul style="list-style-type: none"> <li>i. OMR సమాధాన పత్రం పై హాల్ టికెట్ నంబరును దానికి కేటాయించిన స్థలంలో కాక ఏ ఇతర స్థలంలో రాసినను,</li> <li>ii. పరీక్షకు ఏమాత్రం సంబంధం లేని విషయం ఉదా : మత సంబంధ చిహ్నాలు, పదాలు, ప్రార్థనలు లేదా ఏ ఇతర సమాచారాన్నైనా జవాబు పత్రం పై రాసినట్లయితే,</li> <li>iii. వృత్తాలను నింపటానికి బ్లూ/బ్లాక్ బాల్ పాయింట్ పెన్నులను కాక ఏ ఇతర పెన్నులను ఉపయోగించిననూ,</li> <li>iv. క్వెస్టన్ బుక్ లెట్ నంబర్ లేదా హాల్ టికెట్ నంబర్ లను బల్లింగ్ చేయటం మరచిపోయినను లేదా క్వెస్టన్ బుక్ లెట్ నంబర్ ను నింపే సమయంలో ఒక వరలోని ఒకటి కన్నా ఎక్కువ వృత్తాలను నింపిననూ. అభ్యర్థి తనకు కేటాయించిన హాల్ టికెట్ నంబర్ కాక ఇతర హాల్ టికెట్ నంబరును కాని బల్లింగ్ చేసినచో,</li> <li>v. సమాధాన పత్రం పై వృత్తాలను తప్పుగా/అసంపూర్ణంగా నింపినచో లేక ✓ లేదా ✗ వంటి గుర్తులను వృత్తాలలో గీసినచో,</li> <li>vi. సమాధాన పత్రంలో తెల్ల సిరా (వైట్ నెర్) ను ఉపయోగించినచో,</li> <li>vii. సమాధాన పత్రం పై వృత్తాలను ఛాక్ పీస్ పౌడర్ తో రుద్దటం, ఖాచీ తో గీయటం వంటి చర్యలకు పాల్పడినట్లయితే,</li> <li>viii. ఏ విధమైన మాల ప్రాక్టీస్ పద్ధతులను అవలంబించినను,</li> </ul> <p>19. పై ఏ కారణంవల్లనైననూ అభ్యర్థుల యొక్క సమాధాన పత్రాలను మూల్యాంకనం చేయబడకపోయినా లేదా వారి అభ్యర్థిత్యం రద్దు చేయబడినా, ఈ విషయంలో కమిషన్ తో ఏ విధమైన ఉత్తర ప్రత్యుత్తరములకు అనుమతించబడదు.</p> <p>20. పరీక్షకు హాజరైన అందరి అభ్యర్థుల OMR సమాధాన పత్రాల యొక్క డిజిటల్ కాపీలు ఇమేజ్ స్కానింగ్ అయిన తర్వాత కమిషన్ వెబ్ సైట్ లో అందుబాటులో ఉంచబడును.</p> |
|---|--|



1. The maximum stress intensity due to suddenly applied axial load is
  - (1) half of the stress intensity produced by the same magnitude of gradually applied axial load
  - (2) twice of the stress intensity produced by the same magnitude of gradually applied axial load
  - (3) equal to the stress intensity produced by the same magnitude of gradually applied axial load
  - (4) one-fourth of the stress intensity produced by the same magnitude of gradually applied axial load
  
2. The linear velocity of a body rotating with angular velocity  $\omega$  along a circular path of radius  $r$  is defined as
  - (1)  $\omega^2 r$
  - (2)  $\frac{\omega}{r}$
  - (3)  $\omega r$
  - (4)  $\frac{\omega}{r^2}$
  
3. A vehicle has circular wheel of radius of gyration 0.5 m and mass 1000 kg. If the starting torque of the vehicle is 1000 N-m, the angular acceleration of the wheel is
  - (1)  $4 \text{ rad/s}^2$
  - (2)  $2 \text{ rad/s}^2$
  - (3)  $0 \text{ rad/s}^2$
  - (4)  $0.25 \text{ rad/s}^2$
  
4. The Grubler's criterion for plane mechanisms with constrained motion is given by (where,  $l$  is the number of links and  $j$  is the number of binary joints)
  - (1)  $3l - 2j - 2 = 0$
  - (2)  $3l - 2j - 3 = 0$
  - (3)  $3l - 2j - 4 = 0$
  - (4)  $3l - 2j - 1 = 0$
  
5. The movability of a statically indeterminate structure is
  - (1) 0
  - (2) 2
  - (3) 1
  - (4)  $\leq -1$
  
6. A cantilever beam with concentrated load  $P$  (loaded vertically) at the free end. The strain energy in the beam is due to
  - (1) bending and shearing
  - (2) bending only
  - (3) shearing only
  - (4) stretching only
  
7. For a repeated loading, the alternating stress depends on
  - A. zero stress
  - B. half of the maximum stress
  - C. half of the minimum stress

The correct statements are

  - (1) A and B only
  - (2) B only
  - (3) C only
  - (4) B and C only
  
8. For completely reversed stresses, the stress ratio is
  - (1) 1 : 1
  - (2) 2 : -1
  - (3) 3 : 0
  - (4) 4 : 2
  
9. Theoretical stress concentration factor is defined as
  - (1)  $\frac{\text{Nominal stress}}{\text{Maximum stress}}$
  - (2)  $\frac{\text{Maximum stress}}{\text{Nominal stress}}$
  - (3)  $\frac{\text{Maximum stress}}{\text{Endurance limit}}$
  - (4)  $\frac{\text{Endurance limit}}{\text{Maximum stress}}$



10. Match the following :

- |                   |                         |
|-------------------|-------------------------|
| A. Riveted joints | 1. Permanent fastenings |
| B. Keys           | 2. Temporary fastenings |
| C. Cotters        |                         |
| D. Screwed        |                         |

- (1) A - 1, B - 2, C - 2, D - 2  
 (2) A - 1, B - 2, C - 1, D - 2  
 (3) A - 2, B - 1, C - 2, D - 1  
 (4) A - 2, B - 1, C - 1, D - 2

11. The efficiency of the circumferential lap joint is obtained as

(where  $p_1$  is the pitch of the rivets for the lap joint and  $d$  is the diameter of the rivet hole)

- |                           |                           |
|---------------------------|---------------------------|
| (1) $\frac{p_1 + d}{d}$   | (2) $\frac{p_1 - d}{d}$   |
| (3) $\frac{p_1 - d}{p_1}$ | (4) $\frac{p_1 + d}{p_1}$ |

12. Using Unwin's empirical formula, the relationship between the diameter of the rivet hole ( $d$ ) and the thickness of the plate ( $t$ ) is given by

- |                              |                       |
|------------------------------|-----------------------|
| (1) $\sqrt{t} = \frac{d}{6}$ | (2) $t = \frac{d}{2}$ |
| (3) $t = 6\sqrt{d}$          | (4) $t = 2d$          |

13. The unriveted or solid plate's strength per pitch length is defined as

(where  $\sigma$  is the permissible tensile stress in the plate,  $p$  is the pitch of the rivet,  $d$  is the diameter of the rivet,  $t$  is the thickness of the plate)

- |                 |                      |
|-----------------|----------------------|
| (1) $\sigma pt$ | (2) $\sigma(p - d)t$ |
| (3) $\sigma dt$ | (4) $\sigma(p + t)d$ |

14. Match the following :

- |                                |                   |
|--------------------------------|-------------------|
| A. Shielded arc welding        | 1. Fusion welding |
| B. Electric-resistance welding | 2. Forge welding  |
| C. Gas welding                 |                   |
| D. Thermit welding             |                   |

- (1) A - 2, B - 1, C - 1, D - 1  
 (2) A - 1, B - 1, C - 1, D - 1  
 (3) A - 1, B - 2, C - 2, D - 1  
 (4) A - 1, B - 2, C - 1, D - 1

15. Tensile strength of the butt joint is defined as

(where  $\sigma$  is the permissible tensile stress in the plate,  $t$  is the throat thickness,  $l$  is the length of weld)

- (1)  $2\sigma lt$   
 (2)  $\sigma t^2$   
 (3)  $\sigma tl$   
 (4)  $\sigma l^2$

16. The total elongation of a bar due to its self-weight is

(where  $w$ ,  $L$  and  $E$  are the specific weight, length, and Young's Modulus of the bar respectively)

- (1)  $\frac{wL^2}{E}$   
 (2)  $\frac{w^2L}{E}$   
 (3)  $\frac{w^2L}{2E}$   
 (4)  $\frac{wL^2}{2E}$



17. The volumetric strain of a rectangular body subjected to three mutually perpendicular forces is  
(where  $\sigma_x$ ,  $\sigma_y$  and  $\sigma_z$  are the stresses in x, y and z direction respectively. E and  $\nu$  are Young's modulus and Poisson's ratio respectively)
- (1)  $\frac{\sigma_x + \sigma_y + \sigma_z}{E}$   
 (2)  $\frac{\sigma_x + \sigma_y + \sigma_z}{E} (1 - 2\nu)$   
 (3)  $\frac{\sigma_x}{E}$   
 (4)  $\frac{\nu(\sigma_x + \sigma_y + \sigma_z)}{E}$
18. The unit of shear modulus is same as  
 (1) Force and pressure  
 (2) Young's modulus and flexural rigidity  
 (3) Stress and Young's modulus  
 (4) Force and stress
19. Young's modulus is given by  
(where K and G are bulk and shear modulus respectively)
- (1)  $\frac{9KG}{G + 3K}$  (2)  $\frac{9KG}{3G + K}$   
 (3)  $\frac{3G + K}{9KG}$  (4)  $\frac{12KG}{2G + 3K}$
20. Consider the following statements :
- A. Equal and opposite axial stresses act on two mutually perpendicular planes.  
 B. Equal axial stresses act on two mutually perpendicular planes.  
 C. Planes are free of shear.
- Now, for a Mohr's circle to reduce to a point, which of the following statements is/are true ?  
 (1) A and C only (2) B only  
 (3) B and C only (4) C only
21. For a thin cylindrical shell, the ratio of hoop stress to longitudinal stress is  
 (1) 2 (2)  $\frac{1}{2}$   
 (3) 1 (4) 3
22. For simply supported beams, the bending moment at supports (or ends) is always  
 (1) zero  
 (2) unity  
 (3) inversely proportional to the shear force  
 (4) proportional to the shear force
23. At the point of contraflexure  
 (1) bending moment changes sign  
 (2) shear force is zero  
 (3) shear force is maximum  
 (4) bending moment is maximum
24. The shear force developed in a cantilever beam subjected to a point load P at the free end is  
 (1) P (2) P/2  
 (3) 2P (4) Zero
25. For a cantilever beam carrying uniformly distributed load, the shear force across the length  
 (1) is constant  
 (2) varies quadratically  
 (3) varies linearly  
 (4) varies cubically
26. For a simply supported beam of length L with a triangular load that varies gradually (linearly) from zero at both ends to w per unit length at the centre, the maximum bending moment is  
 (1)  $wL^2$  (2)  $wL/6$   
 (3)  $wL^2/6$  (4)  $wL^2/12$



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27. The modulus of section of a circular cross-section with diameter  $d$  is
- (1)  $\frac{\pi d^3}{32}$  (2)  $\frac{\pi d^2}{16}$   
 (3)  $\frac{\pi d^3}{16}$  (4)  $\frac{\pi d^4}{64}$
28. A cantilever of length  $L$  carries a gradually (linearly) varying load from zero at its free end to  $w$  per unit length at the fixed end. The product of deflection and flexural rigidity at the free end is
- (1)  $wL^3/24$  (2)  $wL^3/30$   
 (3)  $wL^4/30$  (4)  $wL^4/24$
29. For a solid circular shaft under torsion, the strain energy per unit volume is given by (where  $\tau$  is the shear stress and  $G$  is the shear modulus)
- (1)  $\frac{\tau^2}{G}$  (2)  $\frac{\tau^2}{2G}$   
 (3)  $\frac{\tau^2}{4G}$  (4)  $\frac{2\tau^2}{G}$
30. The shear stress developed at the centre of a solid circular shaft under torsion
- (1) maximum (2) zero  
 (3) infinite (4) average
31. The ratio of the equivalent length and actual length of a column with both fixed ends is
- (1)  $1/2$  (2)  $1/\sqrt{2}$   
 (3)  $2$  (4)  $1$
32. The number of instantaneous centres for a 5-link mechanism is/are
- (1) 10 (2) 1  
 (3) 5 (4) 3
33. A screw-jack with helix angle of thread  $\theta$ , and angle of friction  $\beta$  has the maximum efficiency if
- (1)  $2\beta = \frac{\pi}{2} - \theta$  (2)  $2\theta = \frac{\pi}{2} - \beta$   
 (3)  $\theta = \frac{\pi}{2} - \beta$  (4)  $\beta = \frac{\pi}{2} - \theta$
34. Consider the following statements for the force of solid friction ( $P$ ) :
- A.  $P$  is directly proportional to normal reaction between the two surfaces.  
 B. Opposes the motion between the surfaces.  
 C. Does not depend on the material of two surfaces.
- Which of the above statements is/are correct ?
- (1) A only (2) A and B only  
 (3) B only (4) A and C only
35. For an overdamped system, the damping factor is
- (1) equals to 1 (2) less than 1  
 (3) greater than 1 (4) zero
36. For a redundant frame, the number of members ( $m$ ) and the number of joints ( $j$ ) are related as
- (1)  $m = 2j$  (2)  $m < 2j - 3$   
 (3)  $m = 2j - 3$  (4)  $m > 2j - 3$
37. An engine drives the line shaft through a belt of thickness  $t$ . If  $d_1$  and  $d_2$  are the diameter of the follower and driver respectively, the velocity ratio is
- (1)  $\frac{d_1}{d_2}$  (2)  $\frac{d_1 - t}{d_2 - t}$   
 (3)  $\frac{d_1 + t}{d_2 + t}$  (4)  $\frac{d_2 + t}{d_1 + t}$



38. According to the maximum normal stress theory, the diameter of circular shaft subjected to bending moment  $M$  and torque  $T$  is (where  $\sigma_y$  is the yield stress in the uniaxial tensile test and  $N$  is the factor of safety)

- (1)  $\left[ \frac{N}{\pi\sigma_y} (16M + 16\sqrt{M^2 + T^2}) \right]^{\frac{1}{2}}$
- (2)  $\left[ \frac{1}{\pi N\sigma_y} (16M + 16\sqrt{M^2 + T^2}) \right]^{\frac{1}{2}}$
- (3)  $\left[ \frac{1}{\pi N\sigma_y} (16M + 16\sqrt{M^2 + T^2}) \right]^{\frac{1}{3}}$
- (4)  $\left[ \frac{N}{\pi\sigma_y} (16M + 16\sqrt{M^2 + T^2}) \right]^{\frac{1}{3}}$

39. The distortion energy theory is based on the work of

- (1) Rankine
- (2) Tresca
- (3) Von-Mises, Hencky and Huber
- (4) Beltrami

40. The maximum principal stress theory is associated with the name of

- (1) Von-Mises
- (2) Rankine
- (3) Tresca
- (4) Hencky

41. For a simply supported beam carrying distributed load  $w$  per unit length, consider the following relations between shear force  $F$  and bending moment  $M$ .

- A.  $w = -\frac{dF}{dx}$
- B.  $w = -\frac{d^2M}{dx^2}$
- C.  $F = \frac{dM}{dx}$

Which of the above statements is/are correct ?

- (1) A and B only
- (2) B and C only
- (3) A only
- (4) A, B and C

42. For a rectangular cross-section beam subjected to maximum shear force  $F$ , the shear stress at the top edge is

- (1) zero
- (2) maximum
- (3) directly proportional to  $F$
- (4) inversely proportional to  $F$

43. The static deflection at the free end of a cantilever beam with a uniformly distributed load of  $w$  per unit length is

(where  $L$  is the length of the cantilever and  $EI$  is the flexural rigidity)

- (1)  $\frac{wL^3}{3EI}$
- (2)  $\frac{wL^4}{8EI}$
- (3)  $\frac{wL^4}{48EI}$
- (4)  $\frac{wL^3}{48EI}$

44. Consider the following statements for the coefficient of fluctuation of speed ( $K$ ) of flywheel.

- A.  $K = \frac{\text{maximum speed} - \text{minimum speed}}{\text{mean speed}}$
- B.  $K = \frac{\text{maximum fluctuation of energy}}{2 \text{ times kinetic energy of the flywheel at mean speed}}$
- C.  $K = \frac{\text{maximum fluctuation of energy}}{\text{kinetic energy of the flywheel at mean speed}}$

Which of the following statements is/are correct ?

- (1) only A
- (2) only B
- (3) both A and B
- (4) both A and C

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45. For a simply supported beam of length  $L$  carrying concentrated load  $P$  (vertically downward) at the centre. The slope at the ends will be  
(where  $EI$  is the flexural rigidity)
- (1) equal and  $-\frac{PL^2}{16EI}$   
 (2) equal and  $-\frac{PL^2}{4EI}$   
 (3) equal and  $-\frac{PL^3}{48EI}$   
 (4) equal and  $-\frac{PL^2}{EI}$
46. Schottky defect is a following type of imperfection in a crystalline solid  
 (1) Point defect      (2) Line defect  
 (3) Surface defect    (4) Dislocation
47. Which of the following statement is TRUE ?  
 (1) True stress is always less than the engineering stress in the plastic region  
 (2) True stress is always greater than the engineering stress in the plastic region  
 (3) True stress is equal to the engineering stress in the plastic region  
 (4) True stress is always less than the engineering stress in the elastic region
48. The length of a mold sprue is 45 cm and the cross-sectional area at its base is  $5 \text{ cm}^2$ . The sprue feeds a horizontal runner leading into a mold cavity whose volume is  $3000 \text{ cm}^3$ .  
 Determine the time to fill the mold. Assume, gravity,  $g = 10 \text{ m/s}^2$ .  
 (1) 1s                      (2) 2s  
 (3) 10s                    (4) 20s
49. In order to generate a casting with an internal surface, which part is typically used in a casting operation ?  
 (1) Chaplets  
 (2) Riser  
 (3) Core  
 (4) Pattern
50. Which of the following is TRUE regarding the neutral point in a rolling operation ?  
 (1) The velocity of the workpiece is zero  
 (2) The velocity of the rolls is zero  
 (3) The velocity of the workpiece equals the velocity of the rolls  
 (4) The force on the workpiece is zero
51. In an impression die forging, which of the following is NOT a function of the flash ?  
 (1) Forces the material to fill in the intricate details of the die cavity  
 (2) Allows the bulk of the work material to remain in the work cavity  
 (3) Generates compressive pressures on the part in the die cavity  
 (4) Eliminates the need of subsequent machining operation
52. The phenomenon of springback happens in a bending operation due to the following reason  
 (1) Due to the presence of elastic energy in the bent part  
 (2) Due to the presence of plastic energy in the bent part  
 (3) Due to insufficient force imparted on the bent part  
 (4) Due to excessive force imparted on the bent part

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53. Which of the welding process has the highest power density ?
- (1) Oxyfuel welding
  - (2) Resistance welding
  - (3) Arc welding
  - (4) Laser beam welding
54. How can the penetration be improved in a welding process ?
- (1) Decreasing the heat input
  - (2) Lowering travel speed during the welding
  - (3) Increasing travel speed during the welding
  - (4) Increasing travel speed as well as reducing the heat input simultaneously
55. How does the strength of the filler metal in a brazed joint change with increase in clearance ?
- (1) The strength increases
  - (2) The strength decreases
  - (3) The strength decreases, then increases
  - (4) The strength increases, then decreases
56. What is weld bonding ?
- (1) Combination of adhesive bonding and spot welding
  - (2) Combination of adhesive bonding and soldering
  - (3) Combination of adhesive bonding and brazing
  - (4) Combination of adhesive bonding and friction stir welding
57. Which of these joining processes is associated with melting of the base metals ?
- (1) Explosion welding
  - (2) Soldering
  - (3) Brazing
  - (4) Thermit welding
58. Under what conditions, continuous chips with built up edges could be formed ?
- (1) Machining brittle materials at low cutting speeds
  - (2) Machining ductile materials at high cutting speeds
  - (3) Machining ductile materials at low cutting speeds
  - (4) Machining brittle materials at high cutting speeds
59. Which of the following statements is true ?
- (1) The shear angle increases with the increase of the rake angle of a tool and increase of the friction coefficient.
  - (2) The shear angle increases with the increase of the rake angle of a tool and decrease of the friction coefficient.
  - (3) The shear angle increases with the decrease of the rake angle of a tool and increase of the friction coefficient.
  - (4) The shear angle increases with the decrease of the rake angle of a tool and decrease of the friction coefficient.
60. In a cutting tool, the crater wear is found on the following surface
- (1) Principal flank surface
  - (2) Auxiliary flank surface
  - (3) Rake surface
  - (4) Surface of the tool shaft

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61. Which of the following operation does NOT use a rotating tool ?  
 (1) Reaming (2) Centering  
 (3) Counter-boring (4) Facing
62. Which of the following is NOT a valid representation of a solid CAD model ?  
 (1) Spline Representation  
 (2) Octree Representation  
 (3) CSG Representation  
 (4) Boundary Representation
63. A stepping motor has 36 step angles. Its output shaft is coupled to a leadscrew with a 5:1 gear reduction (five turns of the motor shaft moves each turn of the leadscrew). The leadscrew pitch is 5.0 mm. The worktable of a positioning system is driven by the leadscrew. The table must move 50.0 mm from its current position. Determine how many pulses are required to move the table the specified distance.  
 (1) 3600 (2) 360  
 (3) 1800 (4) 180
64. Arrange the following manufacturing technologies from lowest to highest in terms of their production capability per year.  
 (1) Transfer line < Flexible manufacturing cell < Flexible manufacturing system < Standalone NC machine  
 (2) Transfer line < Flexible manufacturing system < Flexible manufacturing cell < Standalone NC machine  
 (3) Standalone NC machine < Flexible manufacturing system < Flexible manufacturing cell < Transfer line  
 (4) Standalone NC machine < Flexible manufacturing cell < Flexible manufacturing system < Transfer line
65. Just-in-time manufacturing is most effective in  
 A. Low volume manufacturing  
 B. High volume manufacturing  
 C. Repetitive manufacturing  
 D. Innovative manufacturing  
 (1) A and C only  
 (2) A and D only  
 (3) B and C only  
 (4) C and D only
66. In an electro discharge machining process, which of the properties are desirable for the dielectric fluid ?  
 A. Chemical neutrality  
 B. High viscosity  
 C. Absence of inflaming tendency  
 D. Low cost  
 (1) A, B, C and D  
 (2) A and D only  
 (3) A, C and D only  
 (4) B, C and D only
67. In an ultrasonic machining process, the material removal rate increases with  
 (1) Increase in the frequency and increase in the amplitude of vibration  
 (2) Increase in the frequency and decrease in the amplitude of vibration  
 (3) Decrease in the frequency and increase in the amplitude of vibration  
 (4) Decrease in the frequency and decrease in the amplitude of vibration

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68. Arrange the materials in increasing order of their hardness.
- (1) Common glass < Aluminium oxide < Hardened steel < Diamond
  - (2) Aluminium oxide < Common glass < Hardened steel < Diamond
  - (3) Common glass < Hardened steel < Aluminium oxide < Diamond
  - (4) Common glass < Aluminium oxide < Diamond < Hardened steel
69. What are the desirable properties of the material that should be used in a cutting tool ?
- A. High ductility
  - B. Hot hardness
  - C. Toughness
  - D. Wear resistance
- (1) A, B and C only
  - (2) B, C and D only
  - (3) A, B, C and D
  - (4) A and D only
70. Following are the reasons for high specific energy requirements in grinding compared to single point tools.
- A. Average rake angle is negative
  - B. Average rake angle is positive
  - C. Plowing consumes additional energy without contributing to chip removal
  - D. Sliding consumes additional energy without contributing to chip removal
- (1) A, C and D only
  - (2) B, C and D only
  - (3) A and C only
  - (4) A and D only
71. Which of the following are characteristics of just-in-time manufacturing ?
- A. Low inventory carrying cost
  - B. Reduced need for inspection
  - C. Presence of large stock in the inventory
  - D. Parts can be retrieved from the storage as and when needed
- (1) A and C only
  - (2) B and C only
  - (3) A and B only
  - (4) C and D only
72. Which of the following statements are true ?
- A. Hot-rolled and hot-drawn products have a wider dimensional tolerances and rougher surface finish than cold-rolled and cold-drawn products.
  - B. Seamless tubing made by the tube-rolling process have more thickness variation than that of roll-formed and welded tubing.
  - C. Castings generally have higher dimensional accuracy and smoother surface finish than parts made by cold extrusion.
  - D. Extrusions have smaller cross-sectional dimensional tolerances than parts made by roll forming.
- (1) A, B and C only
  - (2) A, B and D only
  - (3) B, C and D only
  - (4) A, C and D only



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73. What are the characteristics of job shop production ?

- A. Different product types are produced
- B. Very large quantities are produced
- C. Single type of product is produced
- D. Low quantities of product are produced

- (1) A and B
- (2) C and D
- (3) B and C
- (4) A and D

74. Consider the following defects in castings :

- |              |  |
|--------------|--|
| A. Pinholes  | 1. Metal starts freezing before reaching the farthest point in the cavity  |
| B. Misrun    | 2. Entrapped spherical shaped bubbles  |
| C. Cold shut | 3. Tiny blow holes occurring either at or just below the casting surface   |
| D. Gas holes | 4. Metal starts freezing before reaching the center of the casting for a casting with two gates at its two sides |

Choose the option in which given pairs are correctly matched.

- (1) A – 2, B – 3, C – 4, D – 1
- (2) A – 1, B – 2, C – 3, D – 4
- (3) A – 3, B – 1, C – 4, D – 2
- (4) A – 3, B – 4, C – 1, D – 2

75. Consider the following forming processes :

- |                      |   |
|----------------------|---|
| A. Explosive forming | 1. Axially symmetric parts are generally produced   |
| B. Spinning          | 2. High energy rate forming   |
| C. Stretch forming   | 3. Sheet metal is simultaneously bent and stretched   |
| D. Roll forming      | 4. Continuous bending process in which opposing rolls are used to produce long sections of formed shapes from coil or strip stock |

Choose the option in which given pairs are correctly matched.

- (1) A – 2, B – 1, C – 3, D – 4
- (2) A – 1, B – 2, C – 3, D – 4
- (3) A – 3, B – 1, C – 4, D – 2
- (4) A – 3, B – 4, C – 1, D – 2

76. Consider the following parts in gating design for a casting operation :

- |                  |   |
|------------------|---|
| A. Pouring basin | 1. Used to reduce the pouring force of the molten metal and to maintain a constant pouring head       |
| B. Strainer      | 2. Trap placed in a horizontal gate to prevent impurities from entering the mold                      |
| C. Splash core   | 3. Made of ceramic and placed in the sprue to remove dross  |
| D. Skim bob      | 4. Made of ceramic and placed at the end of the sprue to reduce the eroding force of the molten metal |

Choose the option in which given pairs are correctly matched.

- (1) A – 2, B – 1, C – 3, D – 4
- (2) A – 1, B – 2, C – 3, D – 4
- (3) A – 3, B – 1, C – 4, D – 2
- (4) A – 1, B – 3, C – 4, D – 2



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77. Consider the following energy sources for different machining processes :

- A. Electrochemical machining      1. Electric current and mechanical force
- B. Electrochemical grinding      2. Corrosive agent
- C. Chemical machining      3. Powerful radiation
- D. Laser beam machining      4. Electric current

Choose the option in which given pairs are correctly matched.

- (1) A – 2, B – 1, C – 3, D – 4
- (2) A – 4, B – 2, C – 3, D – 1
- (3) A – 3, B – 1, C – 4, D – 2
- (4) A – 4, B – 1, C – 2, D – 3

78. Consider the following different zones in an electric arc :

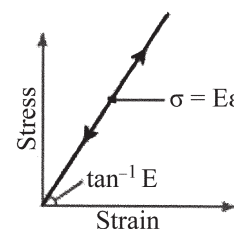
- A. Cathode spot      1. Gaseous region with a sharp drop in voltage
- B. Anode space      2. Area where electrons are absorbed
- C. Anode spot      3. Voltage drop is not sharp
- D. Arc column      4. Small area emitting the electrons

Choose the option in which given pairs are correctly matched.

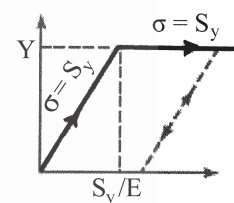
- (1) A – 2, B – 1, C – 3, D – 4
- (2) A – 4, B – 2, C – 3, D – 1
- (3) A – 4, B – 1, C – 2, D – 3
- (4) A – 2, B – 1, C – 4, D – 3

79. Consider the following curves for idealized stress-strain curves :

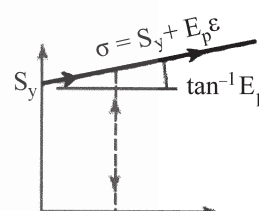
A. Rigid perfectly plastic



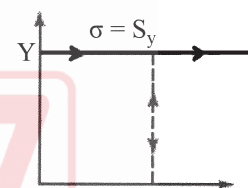
B. Rigid linearly strain hardening



C. Perfectly elastic



D. Elastic, perfectly plastic



Choose the option in which given pairs are correctly matched.

- (1) A – 2, B – 3, C – 4, D – 1
- (2) A – 1, B – 2, C – 3, D – 4
- (3) A – 4, B – 3, C – 1, D – 2
- (4) A – 3, B – 4, C – 1, D – 2

80. Suppose, in an orthogonal cutting operation, the cutting force and the thrust force are  $F_c = 1500 \text{ N}$  and  $F_t = 1170 \text{ N}$ . Assuming rake angle,  $\alpha = 0^\circ$ , calculate the normal force to the friction.

- (1) 1170 N      (2) 1900 N
- (3) 1500 N      (4) 2670 N



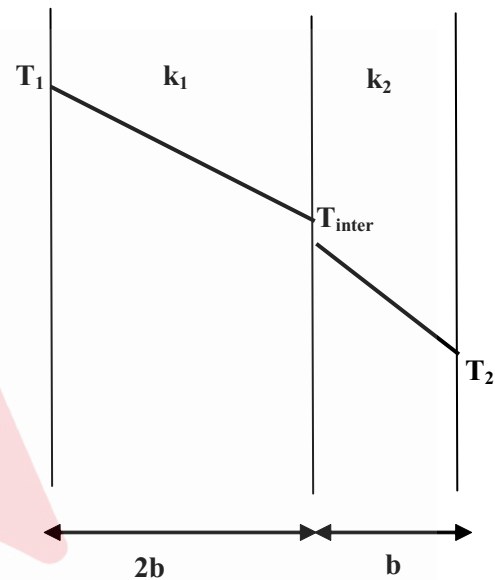
81. The Chvorinov's rule for calculating the solidification time for the volume of a casting is proportional to
- (1)  $\left(\frac{\text{Volume}}{\text{Surface Area}}\right)^2$
  - (2)  $\left(\frac{\text{Surface Area}}{\text{Volume}}\right)^2$
  - (3)  $\text{Volume}^2$
  - (4)  $(\text{Surface Area})^2$
82. What is the process called through which the pores of a powder metallurgy part are filled with a molten metal ?
- (1) Metallization
  - (2) Infiltration
  - (3) Impregnation
  - (4) Filling
83. Any linear programming model must have all the following properties EXCEPT
- (1) the relationship between variables and constraints must be non-linear
  - (2) the model must have an objective function
  - (3) the model must have non-negativity constraints
  - (4) the model must have structural constraints
84. Which is the sequence of operations in a conventional powder metallurgy process ?
- (1) Atomization → Blending and Mixing → Compacting → Sintering
  - (2) Atomization → Blending and Mixing → Sintering → Compacting
  - (3) Blending and Mixing → Compacting → Atomization → Sintering
  - (4) Blending and Mixing → Atomization → Compacting → Sintering
85. Which of the welding process uses a consumable electrode ?
- (1) Submerged arc welding
  - (2) Gas tungsten arc welding
  - (3) Plasma arc welding
  - (4) Carbon arc welding
86. The unit of thermal conductivity is
- (1) W/m K
  - (2) W/m<sup>2</sup> K
  - (3) W/m<sup>2</sup> K<sup>2</sup>
  - (4) W<sup>2</sup>/m K
87. Consider the following statements :  
The heat conduction equation for a medium is given as
- $$\frac{\partial^2 T}{\partial x^2} = \frac{1}{\alpha} \frac{\partial T}{\partial t}$$
- A. The heat transfer is steady.
  - B. The heat transfer is transient.
  - C. The heat transfer is one-dimensional.
  - D. The thermal conductivity of the medium is constant.
- Of these statements :
- (1) A and C are correct
  - (2) A and D are correct
  - (3) A, C and D are correct
  - (4) B, C and D are correct
88. 1.5 kg of water at 20°C will be heated to 90°C in a teapot with a 1500 Watt electric heater. The teapot weighs 0.75 kg and has an average specific heat of 0.8 kJ/kg°C. Consider the specific heat of the water to be 4.18 kJ/kg°C. Determine how long it will take to heat the water, assuming no heat loss from the teapot also, assume that the properties of both water and teapot remain constant during the heating process.
- (1) 302.5 seconds
  - (2) 292.6 seconds
  - (3) 320.6 seconds
  - (4) 318.5 seconds



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89. Consider two walls, 1 and 2, both have the same surface area and the same temperature drop across their thickness. The ratio of the thermal conductivity between two walls is given as  $k_1/k_2 = 2$ . The thickness ratio between the two walls is given as  $L_1/L_2 = 4$ . Then the ratio of the heat transfer rate between the two walls  $Q_1/Q_2$  will be
- (1) 0.5 (2) 1  
(3) 2 (4) 4
90. A hollow cylinder has length  $L$ , inner radius  $r_1$ , outer radius  $r_2$  and thermal conductivity  $K$ . The thermal resistance of the cylinder for radial conduction is
- (1)  $\ln(r_1/r_2)/2\pi KL$   
(2)  $\ln(r_2/r_1)/2\pi KL$   
(3)  $2\pi KL/\ln(r_1/r_2)$   
(4)  $2\pi KL/\ln(r_2/r_1)$
91. Thermal diffusivity of a substance is
- (1) Inversely proportional to thermal conductivity  
(2) Directly proportional to thermal conductivity  
(3) Directly proportional to the square of thermal conductivity  
(4) Inversely proportional to the square of thermal conductivity
92. If the thermal conductivity of insulating material is  $K$  ( $\text{W/m K}$ ) and the surface heat transfer coefficient  $h$  ( $\text{W/m}^2 \text{ K}$ ), then the critical radius of insulation for the cylinder is given by
- (1)  $2K/h$   
(2)  $K/2h$   
(3)  $K/h$   
(4)  $h/K$

93. The temperature at the interface ( $T_{\text{inter}}$ ) of the composite wall shown in the figure below is equal to the average temperature at the two ends. Assuming steady one-dimensional heat conduction, with equal height and depth of the entire wall.



Which of the following options is true about the respective thermal conductivities ?

- (1)  $2k_1 = k_2$   
(2)  $k_1 = k_2$   
(3)  $2k_1 = 3k_2$   
(4)  $k_1 = 2k_2$
94. Which of the following statement is TRUE ?  
Fins are used to enhance heat transfer from a heated surface by
- (1) Increasing the effective surface area.  
(2) Increasing the convective heat transfer coefficient.  
(3) Increasing the temperature difference.  
(4) Decreasing the effective surface area.



95. The ratio

$$\frac{\text{Conduction resistance within the body}}{\text{Convective resistance at the surface of the body}}$$

is known as

- (1) Nusselt number
- (2) Stanton number
- (3) Biot number
- (4) Grashof number

96. Consider the following :

- |   |   |
|---|---|
| A. Forced convection                              | 1. Reynolds, Grashof and Prandtl number |
| B. Natural convection                             | 2. Reynolds and Prandtl number          |
| C. Combined free and forced convection            | 3. Fourier modulus and Biot number      |
| D. Unsteady conduction with convection at surface | 4. Prandtl number and Grashof number    |

Choose the option in which given pairs are correctly matched.

- (1) A – 2, B – 4, C – 1, D – 3
- (2) A – 3, B – 1, C – 4, D – 2
- (3) A – 3, B – 4, C – 2, D – 1
- (4) A – 1, B – 2, C – 3, D – 4

97. Consider a fully developed flow in a circular pipe of diameter 20 cm with an average velocity of 1 m/s. The fluid flowing in the pipe has a kinematic viscosity of  $0.00016 \text{ m}^2/\text{s}$  and thermal conductivity of  $2.0 \text{ W/m-K}$ . The heat transfer coefficient for constant heat flux and constant wall temperature boundary conditions are, respectively

- (1) 36.6 and  $43.6 \text{ W/m}^2 \text{ K}$
- (2) 43.6 and  $36.6 \text{ W/m}^2 \text{ K}$
- (3)  $36.6 \text{ W/m}^2 \text{ K}$  for both the cases
- (4)  $43.6 \text{ W/m}^2 \text{ K}$  for both the cases

98. In a counter-flow heat exchanger, a hot fluid is cooled from  $100^\circ\text{C}$  to  $70^\circ\text{C}$  by using a cold fluid that gets heated from  $25^\circ\text{C}$  to  $55^\circ\text{C}$ . The LMTD value of the heat exchanger is

- (1)  $45^\circ\text{C}$
- (2)  $25^\circ\text{C}$
- (3)  $70^\circ\text{C}$
- (4)  $100^\circ\text{C}$

99. For an opaque body, the relationship between reflectivity ( $\rho$ ), absorptivity ( $\alpha$ ) and transmissivity ( $\tau$ ) is given as

- (1)  $\rho + \alpha + \tau = 0$
- (2)  $\rho + \alpha = \tau$
- (3)  $\rho + \alpha = 0$
- (4)  $\rho + \alpha = 1$

100. What will be the value of the shape factor for two infinite parallel surfaces separated by a distance  $d$  ?

- (1) 0
- (2)  $\infty$
- (3) 1
- (4)  $d$

101. The coefficient of performance (COP) of a refrigerator working as a heat pump is given by

- (1)  $(\text{COP})_{\text{heat pump}} = (\text{COP})_{\text{refrigerator}}$
- (2)  $(\text{COP})_{\text{heat pump}} = (\text{COP})_{\text{refrigerator}} - 1$
- (3)  $(\text{COP})_{\text{heat pump}} = (\text{COP})_{\text{refrigerator}} + 1$
- (4)  $(\text{COP})_{\text{heat pump}} = (\text{COP})_{\text{refrigerator}} + 2$



102. Consider the following :

The various process with their types for an air refrigerator working on a Reverse Brayton cycle is given below :

- |                    |                |
|--------------------|----------------|
| A. Compression     | 1. Isobaric    |
| B. Heat rejection  | 2. Isothermal  |
| C. Expansion       | 3. Isentropic  |
| D. Heat absorption | 4. Isenthalpic |

Choose the option in which given pairs are correctly matched.

- (1) A – 3, B – 1, C – 4, D – 2
- (2) A – 3, B – 2, C – 3, D – 2
- (3) A – 3, B – 1, C – 2, D – 2
- (4) A – 3, B – 1, C – 3, D – 1

103. When a mixture of air and water vapour is cooled at constant pressure upto saturation temperature of water vapour, the temperature attained is known as

- (1) Wet bulb temperature
- (2) Dew point temperature
- (3) Critical temperature
- (4) Dry bulb temperature

104. A gas engine working on Otto cycle has a clearance volume 10% of the swept volume. Then the compression ratio value is

- (1) 8
- (2) 9
- (3) 10
- (4) 11

105. An engine having a brake thermal efficiency of 40% produces 20 kW brake power. What is the fuel consumption if the fuel used has a calorific value of 60,000 kJ/kg ?

- (1) 3.0 kg/hour
- (2) 0.3 kg/hour
- (3) 1.0 kg/hour
- (4) 2.0 kg/hour

106. Choose the correct option for the critical pressure and temperature of water.

- (1) 221 bar and 374°C
- (2) 221 bar and 354°C
- (3) 181 bar and 374°C
- (4) 181 bar and 354°C

107. Consider the following and choose the only option in which the pairs are matched correctly.

- |                     |  |
|---------------------|--|
| A. Isolated system  | 1. One in which mass cannot cross the boundary                       |
| B. Open system      | 2. One which exchanges neither mass nor energy with its surroundings |
| C. Closed system    | 3. One which is thermally insulated from its surroundings            |
| D. Adiabatic system | 4. One in which mass flows into or out of the system                 |

- (1) A – 2, B – 1, C – 3, D – 4
- (2) A – 4, B – 1, C – 2, D – 3
- (3) A – 2, B – 4, C – 1, D – 3
- (4) A – 1, B – 3, C – 2, D – 4

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108. Select the right expression for Van der Waal's equation for a real gas.
- (1)  $\left(p + \frac{a}{v^2}\right)(v^2 - b) = RT$
  - (2)  $\left(p + \frac{a}{v^2}\right)(v - b) = RT^2$
  - (3)  $\left(p + \frac{a}{v}\right)(v^2 - b) = RT$
  - (4)  $\left(p + \frac{a}{v^2}\right)(v - b) = RT$
109. Calculate the specific enthalpy of a given substance at a temperature of  $25^\circ\text{C}$  and pressure of 25 MPa, whose specific internal energy and specific volume are given as 41 kJ/kg and  $0.0005 \text{ m}^3/\text{kg}$  respectively.
- (1) 103 kJ/kg
  - (2) 53.5 kJ/kg
  - (3) 10.3 kJ/kg
  - (4) 5.35 kJ/kg
110. The specific heat of an ideal gas depend on its
- (1) Density
  - (2) Molecular weight
  - (3) Pressure
  - (4) Temperature
111. Select the process that occurs without a change in the internal energy.
- (1) Isentropic process
  - (2) Isobaric process
  - (3) Isochoric process
  - (4) Isothermal process
112. Which of the following statements pertaining to entropy are correct ?
- A. The entropy of a system reaches its minimum value when it is in a state of equilibrium with its surroundings.
  - B. Entropy is conserved in all reversible processes.
  - C. Entropy of a substance is least in solid phase.
  - D. Entropy of a solid solution is not zero at absolute zero temperature.
- (1) A, B and C only
  - (2) A and C only
  - (3) B, C and D only
  - (4) B and D only
113. According to the Clausius statement, which of the following is true ?
- (1) Heat can transfer from a cooler body to a hotter body without any external work.
  - (2) Heat cannot transfer from a cooler body to a hotter body without any external work.
  - (3) Heat cannot transfer from a hotter body to a cooler body without any external work.
  - (4) Heat cannot transfer from a cooler body to a hotter body with any external work.
114. In a non-flow reversible system, the work done per unit mass is expressed as
- (1)  $W = T.ds - (u_0 - u_1)$
  - (2)  $W = T.ds + (u_0 - u_1)$
  - (3)  $W = T.ds - (h_0 - h_1)$
  - (4)  $W = T.ds + (h_0 - h_1)$

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115. For a perfect gas, which of the following is true ?
- (1)  $S_2 - S_1 = c_v \ln \frac{T_2}{T_1} - R \ln \frac{P_2}{P_1}$
  - (2)  $S_2 - S_1 = c_p \ln \frac{T_2}{T_1} - R \ln \frac{P_1}{P_2}$
  - (3)  $S_2 - S_1 = c_v \ln \frac{T_1}{T_2} - R \ln \frac{P_2}{P_1}$
  - (4)  $S_2 - S_1 = c_p \ln \frac{T_2}{T_1} - R \ln \frac{P_2}{P_1}$
116. Among the polytropic processes, which is the correct one for  $n = 1$  ?
- (1) Adiabatic process
  - (2) Reversible process
  - (3) Isothermal process
  - (4) Irreversible process
117. An example of a nearly reversible process is
- (1) Electricity through a resistance
  - (2) Expansion and compression of spring
  - (3) Combustion and heat transfer
  - (4) Plastic deformation
118. Identify the correct statements in the following with respect to heat and work.
- A. They are exact differentials.
  - B. They are path functions.
  - C. They are boundary phenomena.
  - D. They are point functions.
- (1) A, B and C only
  - (2) A, C and D only
  - (3) B, C and D only
  - (4) B and C only
119. What happens to the entropy if a closed system undergoes an irreversible process ?
- (1) can increase, decrease or remain constant
  - (2) must decrease
  - (3) must increase
  - (4) remains constant
120. The relation for specific heats is given by
- (1)  $C_p - C_v = \frac{vT\beta^2}{K}$
  - (2)  $C_v - C_p = \frac{vT\beta^2}{K}$
  - (3)  $C_p - C_v = \frac{vT}{K\beta^2}$
  - (4)  $C_p - C_v = \frac{pT\beta^2}{K}$
121. The compression process for uncooled rotary compressor is
- (1) isothermal
  - (2) reversible
  - (3) isochoric
  - (4) adiabatic
122. In Carnot cycle, the thermal efficiency may be increased by
- (1) increasing the highest temperature
  - (2) decreasing the lowest temperature
  - (3) increasing the lowest temperature
  - (4) keeping the lowest temperature constant

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123. The thermodynamic difference between a Rankine cycle working with saturated steam and the Carnot cycle is that
- (1) Heat is supplied to water at temperature below the maximum temperature of the cycle
  - (2) Rankine cycle is hypothetical
  - (3) A Rankine cycle receives heat at two places
  - (4) Carnot cycle can't work with saturated steam
124. In a Brayton cycle for a power plant, choose the option that arranges the following processes in the correct sequence.
- A. Isobaric heat addition (Q added)
  - B. Isentropic compression (W added)
  - C. Isobaric heat rejection (passive exhaust)
  - D. Isentropic expansion (W extracted)
- (1) A, C, D, B
  - (2) A, D, B, C
  - (3) B, A, D, C
  - (4) B, C, D, B
125. Comparing the case of intercooling with no intercooling, the heat supplied in Brayton cycle is
- (1) lower
  - (2) greater
  - (3) varying
  - (4) constant
126. Which of the following statements are true ?
- A. A streak line is a curve connecting all points in the flow along which a fluid particle moves in time
  - B. Two stream lines can never cross each other
  - C. For a steady flow, path lines, stream lines and streak lines coincide
  - D. The separation between two stream lines is proportional to the velocity
  - E. Path line and streak line originating from a point in flow can never intersect elsewhere in the flow
- (1) A, C and D
  - (2) B and C
  - (3) B and D
  - (4) A, B, D and E
127. The discharge in  $\text{m}^3/\text{s}$  for laminar flow through a pipe of diameter 0.04 m having a centre line maximum velocity 1.5 m/s is
- (1)  $3\pi/50$
  - (2)  $3\pi/2500$
  - (3)  $3\pi/10000$
  - (4)  $3\pi/5000$
128. The resultant upward pressure of the fluid on an immersed body due to its tendency to uplift the submerged body is called
- (1) Meta centre
  - (2) Centre of pressure
  - (3) Centre of gravity
  - (4) Buoyancy
129. In laminar flow through round tube, the discharge varies
- (1) linearly as the viscosity
  - (2) inversely as the viscosity
  - (3) as the cube of the diameter
  - (4) inversely as the pressure drop
130. Select the correct dimensions for surface tension among the following.
- (1) J/m
  - (2) Nm
  - (3)  $\text{W}/\text{m}^2$
  - (4)  $\text{J}/\text{m}^2$
131. For any arbitrary floating body in a liquid, the line of action of the buoyancy force acts through
- (1) The centre of mass of the floating body
  - (2) The centre of gravity of the floating body
  - (3) The centroid of the displaced volume
  - (4) The lowest point of the displaced volume
132. A stream line and an equipotential line in the flow field
- (1) are perpendicular to each other
  - (2) are identical
  - (3) are parallel to each other
  - (4) intersect at an acute angle



133. Working principle of hydraulic lift is based on
- (1) Bernoulli's Principle
  - (2) Archimedes' Principle
  - (3) Pascal's Law
  - (4) Newton's Law
134. Which among the following is a wrong assumption to derive Bernoulli equation ?
- (1) Irrotational Flow
  - (2) Viscous Flow
  - (3) Steady Flow
  - (4) Incompressible Flow
135. Match the following :
- |                |  |
|----------------|--|
| A. Pressure    | 1. Thermocouple                        |
| B. Velocity    | 2. Venturimeter                        |
| C. Flow rate   | 3. Manometer                           |
| D. Temperature | 4. Prandtl tube<br>(Pitot Static Tube) |
- (1) A – 2, B – 4, C – 1, D – 3
  - (2) A – 4, B – 3, C – 2, D – 1
  - (3) A – 3, B – 4, C – 2, D – 1
  - (4) A – 2, B – 4, C – 3, D – 1
136. An incompressible fluid flow over a flat plate with zero pressure gradient. The boundary layer thickness is 1 mm at location where the Reynolds number is 1000. If the velocity of the fluid alone increased by a factor 4, then the boundary layer thickness at the same location is
- (1) 4 mm
  - (2) 2 mm
  - (3) 0.25 mm
  - (4) 0.5 mm
137. Stream function \_\_\_\_\_ along a stream line.
- (1) is zero
  - (2) is not defined
  - (3) is constant
  - (4) increases
138. In a horizontal pipe of diameter  $d$  mm and length  $l$  m carrying oil, whose friction factor is  $f$ . If the acceleration due to gravity is  $g$  m/s<sup>2</sup> and fluid velocity  $v$  m/s, then the head loss due to friction is given by
- (1)  $flv^2/8gd$
  - (2)  $flv^2/6gd$
  - (3)  $flv^2/2gd$
  - (4)  $flv^2/4gd$
139. A floating body can attain stable equilibrium if
- (1) Meta center point is parallel to the center of gravity
  - (2) Meta center point coincides with the center of gravity
  - (3) Meta center point is below the center of gravity
  - (4) Meta center point is above the center of gravity
140. A Bourdon tube can be used to measure
- (1) Pressure
  - (2) Density
  - (3) Velocity
  - (4) Temperature
141. Assuming that the temperature of the air is constant and that the air is an ideal gas, the atmospheric pressure variation with altitude is
- (1) linear
  - (2) quadratic
  - (3) cubic
  - (4) exponential
142. For a 2-dimensional flow, vorticity is
- (1) Zero
  - (2) Constant
  - (3) Not defined
  - (4) Unsteady
143. The region between the separation of stream line and the boundary surface of a solid body is known as
- (1) wake
  - (2) drag
  - (3) lift
  - (4) boundary layer

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144. Cavitation in a hydro propeller is mainly caused by
- (1) Wear and tear due to constant movement of propellers in water
  - (2) Low pressure region formed due to the relative motion of the fluid and propeller blades
  - (3) Increased torque on the propeller leading to increased temperature of fluid around the propeller
  - (4) Impingement of contaminants in water on the surface of the propeller
145. Most appropriate turbine to extract energy from water flow when the pressure head, volume flow rate, and total power output are high is
- (1) Pelton Turbine
  - (2) Francis Turbine
  - (3) Kaplan Turbine
  - (4) Cross Flow Turbine
146. Match the following considering the context of a single-stage axial turbine (assume no frictional and heat losses, and that the radial flow is negligible).
- |                   |   |
|-------------------|---|
| A. Across rotor   | 1. Stagnation enthalpy is constant          |
| B. Across stator  | 2. Relative stagnation enthalpy is constant |
| C. Across a stage | 3. Enthalpy is constant                     |
- (1) A-2 and 3; B-1, 2 and 3; C matched to none
  - (2) A-2 and 3; B matched to none; C-1, 2 and 3
  - (3) A-1 and 3; B-1 and 3; C-3
  - (4) A-2 and 3; B-1 and 2; C-1 and 2
147. The range of specific speed of a Kaplan turbine is
- (1) 30 to 60
  - (2) 300 to 600
  - (3) 60 to 300
  - (4) 600 to 1000
148. A stator in a turbine
- (1) Adds energy to the flow in terms of work
  - (2) Redirects and accelerates/decelerates the flow
  - (3) Is otherwise known as a stage of the turbomachinery
  - (4) Cannot alter the static pressure of the fluid flow
149. What is a reasonable assumption for a flow through a turbine or a compressor ?
- (1) Isothermal
  - (2) Isochoric
  - (3) Adiabatic
  - (4) Isobaric
150. The degree of reaction of an impulse stage of a turbine or compressor is
- (1) One
  - (2) Infinity
  - (3) 0.5
  - (4) Zero

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